Kalpatharu Research Academy Publication No. 5

AN INTEGRATED THEORY OF THE EARTH

(A Comparative Study of Eastern and Western Theories)

IT
164

[redacted] ESEARCH ACADEMY
GALORE

राष्ट्रिय संस्कृत संस्थान, जयपुर
परिसर

वर्गीकरण सं. ....

पुस्तक सं. 12165 दिनाङ्क..................

यह पुस्तक नीचे अङ्कित तिथि या उससे पूर्व लौटा दी जानी चाहिये। यदि पुस्तक निर्धारित तिथि से अधिक समय तक पाठक अपने पास रखेंगे तो 50 पैसे प्रतिदिन के हिसाब से विलम्ब शुल्क देय होगा।

[illegible]

राष्ट्रिय संस्कृत संस्थान
जयपुर परिसर, जयपुर
पुस्तकालय
क्रमांक.........
12164

Kalpatharu Research Academy Publication No. 6

Chief Editor :

DAIVAJNA K. N. SOMAYAJI

AN INTEGRATED THEORY OF THE EARTH

(A Comparative Study of Eastern and Western Theories)

By :

S. R. N. MURTHY

Foreword by :

Prof. K. T. PANDURANGI

12.2D

1987

KALPATHARU RESEARCH ACADEMY
POST BOX NO. 1857, BANGALORE-560 018

AN INTEGRATED THEORY OF THE EARTH (English) —by S. R. N. Murthy (Kalpatharu Research Academy Publication No. 5); Chief Editor: Daivajna K. N. Somayaji. Pages 127 + xvii

Published by Kudinalli Narasimha Somayaji - Daivajna Director, Kalpatharu Research Academy, P. B. No. 185 Bangalore-560 018.

© Kalpatharu Research Academy, Bangalore.

Cover Illustration: by Prof. S. K. Ramachandra Rao [A sculptural panel from the Badami Caves in Karnataka. It depicts Vishnu in his Varaha incarnation to re-establish Earth (Bhu-Varaha)].

JACL-KRC
012164

First Edition: 1987

Printed by: Y. V. Keshava Murthy, Managing Director, Praja Printers (P.) Limited (National Award Winners), Praja Bhavan, 53/2, Bull Temple Road, Bangalore-560 019 (Karnataka)
Grams: 'PRAJA' Phone: 604261

DEDICATED TO MY PARENTS

Kalpatharu Research Academy

Institution for :

- Promotion of Research-oriented scholarship in Veda, Vedanga, Agama, Jyotisha, Vedanta and Yoga.

- Study of Sanskrit language in particular and other related languages.

- Propagation of Vedic phonetics.

- Running of Libraries.

- Development of Journalism in Sanskrit, Manuscriptology and Literary Criticism.

- Collection, Preservation and Publication of old manuscripts (Tadapatras).

- Running of Veda Patashala (on traditional method).

FOREWORD

The study of the theories of Earth both ancient and modern is a very fascinating study.

Modern geologists have made a good deal of advance in the study of origination, growth and the components of the earth. Not only geologists but astronomers, astrophysicists, physicists, chemistry scholars, biologists, ecologists and even social scientists have made a study of the earth.

Any study of the earth has to take into account the fact that it is a part of a much wider Universe. They also have to take into account the presence of other planets in the Universe. These act and react on each other. These maintain a kind of equilibrium. No event either on earth or on other planets is an isolated event. Similarly the various components of the earth also act and re-act on each other. There is a law behind all these happenings. The entire process of the origination and growth of the earth and other planets has a time sequence. Though man has not yet acquired adequate instruments to measure and predict these events, these can be measured and predicted.

The study of earth though very much advanced in recent years is very old. Ancient Vedic seers and scholars of astronomy have made a deep study of the nature of the earth. The ancient Greek and Roman thinkers also have bestowed a good deal of thought.

In Rigveda all the features of the earth, i.e., rivers, mountains, sea, wind, storm, rain, forest, lightning are described in detail. This description is not to be dismissed as merely poetic. It reveals first-hand knowledge of geological features. This description of the earth is made in the background of the whole Universe. References to other planets are found. Vedic seers were aware of the nine planets and twenty-seven stars. Astronomy was developed as Vedanga Jyotisha. A careful compilation of the geological and astronomical data spread over the entire Veda is bound to be very useful for a study of Vedic earth theory. Varahamihira's Brihatsamhita is another important source of the theory of earth developed in India by the astronomers. The Puranas are another source. The theories of Kalpa, Manvantara, Mahayuga and Yuga give us an idea of the duration of the life of the Universe and earth. The figures given here are not fantastic or mythical. In some respects, particularly so far as the life of earth is concerned, these calculations approximate modern calculations. Another interesting feature of Indian earth study is to take into account the life on the earth also. Not only non-sentient entities constitute the earth but even the sentient creatures form an important aspect of the earth. So far no other planet is known to possess living beings according to modern scientists.

Ancient Greek and Roman scholars such as Anaximenes, Herodotus, Aristotle have also given their theories of earth. Among the modern scholars Buffon, Maillet, Hutton, etc., have made significant contribution.

In this interesting book Sri S. R. N. Murthy gives a brief but very informative account of the theories of the earth propounded by Vedic seers, Indian astronomers, Greek and Roman thinkers and modern scholars. He advocates that an integrated theory of earth be developed. By integrated theory he means twofold integrations :

1. An integrated theory of earth that takes into account the views of the ancient thinkers of Greece, Roman, Vedic and modern scientists finding as much common ground as is possible.

2. An integrated theory taking into account the views of geologists, astronomers, astrophysicists, physicists biologists, etc., who have bestowed their thought on the theory of earth. Isolated studies by the scholars of different disciplines lead to incomplete and inadequate results. Sometimes, these studies even lead to conflicting results. Therefore, after certain amount of separate studies in different disciplines, it is worthwhile to take an integrated view of the whole problem and evolve an integrated theory.

Sri S. R. N. Murthy has made a good beginning in this direction and deserves our appreciation. I particularly congratulate him for bringing together the ancient and modern thought in one book. I hope he will continue this very useful programme further.

K. T. Pandurangi
Former Professor of Sanskrit,
Bangalore University,
President, Mythic Society

2-10-1987

KALPATHARU RESEARCH ACADEMY
BANGALORE

The Kalpatharu Research Academy established in 1981, was inaugurated by the then Hon'ble Minister for Tourism & Civil Aviation, Government of India. This is an institution dedicated to the cause of the preservation of heritage of India. Its broad aim is to promote research-oriented scholarship in the different branches of knowledge relating to the Vedas and Sanskrit. Encouragement is meant to be given through the Academy to the study of the Vedic literature along with the traditional angas including Siksha, Vyakarana, Chandas, Nirukta, Kalpa and Jyothisha. It also promotes work in related disciplines, Manuscriptology, Etymology, Linguistic Sciences, Lexicology and Literary Criticism. Generally, the Academy will help spread and promote education, culture, science, art and learning in all its branches. It will be broad-based and multi-disciplinary in approach.

In order to further its main objective of encouraging studies in the field of Veda and Vedanga, various research projects have been taken up and also major research work on Rig-Veda in several volumes and Encyclopaedia on Agama, Shilpashastra and Temple Architecture, Dharmashastra, etc. A reference library is being built up to assist the research work by the scholars engaged by the Academy and also students in

Vedic studies. It is the intention of the Academy to develop as a National Centre for higher learning in Vedas and to facilitate the founding of a Sanskrit and Vedic University in India (Gurukula System).

This publication is the fifth of its achievements in this field.

Director,
for Kalpatharu Research Academy,
Bangalore.

A WORD FROM PUBLISHER

I have great pleasure in bringing out this book which is dedicated to the cause of preservation of heritage of Indian culture especially in the field of Veda and Vedanga. This book is an excellent piece of epic in the field of Research work. This is the fifth publication of Kalpatharu Research Academy, prepared with great devotion by Dr. S. R. N. Murthy, well-known scholar in the field of Sanskrit and Indology. He was kind enough to oblige the Academy by agreeing to complete this monumental work as a short-term project of Academy. The work is acknowledged with respect and admiration.

The Academy is greatly indebted to Pujya Sri S. K. Ramachandra Rao for his valuable suggestion and wonderful cover page design. Also academy is highly thankful to Pujya Sri K. T. Pandurangi, Prof. of Sanskrit (Retd.), Bangalore University, for his scholarly Foreword which he has been kind enough to write for this book.

I personally and on behalf of the Academy thank every one who was associated and has helped in bringing out this publication more particularly the printing of monograph by M/s. Praja Printers Pvt. Ltd., Bangalore, who have done excellent job of it.

I am sure that this book will immensely benefit one and all in the sphere of Vedic studies.

Prabhava Ashwija
Vijaya Dashami
2-10-1987
Bangalore

Daivajna K. N. Somayaji
Director,
Kalpatharu Research Academy

PREFACE

As a student of the Earth Sciences for over three decades, the author having gone through considerable literature in Earth Science both in English and Sanskrit languages has realised that there is scope for development of a sound Theory of the Earth by integrating suitably the materials of many theories of the earth existing in the literatures of the orient and the occident, coupled with modern observations in celestial dynamics. The need for a sound Theory of the Earth cannot be over emphasised as for its application in predicting from daily weather to occurrences of earthquakes and volcanoes. The inadequacy of such a theory is the cause of our present erroneous observations and the need for improving over the earlier theories is very much felt. Towards this end the author has made attempt to gather information on various theories of the earth developed in the western schools of thought and also in the eastern schools of thought, especially from the Vedic school. The students of the earth from Vedic times to the times of Brihat Samhita of Varahamihira (5th Century A.D.), have made many observations in developing a theory of the earth based on which the various local almanacs in India predict the rains, etc., for each year in advance, to this day. The earth science disciplines of modern science as developed in the western schools have systematised observations but appear to lack co-ordination amongst meteorology, seismology, astronomy, geology, economics, politics and sociology as a result the benefit of advancement due to research in one field is not available for the sister disciplines. The untold sufferings of humanity due to natural calamities can be reasonably overcome if only a co-ordinated interpretation is made of the disciplines stated above by giving notice sufficiently early as to the occurrence of volcanoes, earthquakes, storms, floods, etc.

In the following pages an attempt is made to bring out the information with regard to a theory of the Earth and an Integrated Theory is put forth based on data from celestial dynamics. Based on this theory an attempt is being made to forecast deep focus earthquakes well in time to be confirmed by the observations —however emperical—made by the author of Brihat Samhita in the Chapter 'Bhukampalakshana'.

It has been a pleasure to trace the development of the ideas with regard to a Theory of the Earth both in the West and in the East. The developments in modern science of Geology can only be described as nothing less than spectacular. Even then there is a long way yet to the time when a reliable Theory of the Earth can be instituted.

The section on 'Varahamihira's contribution to the Vedic Theory of the Earth' was presented by the author to the Third International Sanskrit Conference held in Paris in 1977. The book is being published by the Kalpatharu Research Academy, Bangalore, for which the author expresses his thankfulness to them and in particular to Shri Daivajna K. N. Somayaji, who is its Chief Editor.

The typescript was improved by Sri M. N. Lakshminarasimha Sastrigal, Head Master, Sarada Vilas High School, Mysore (Retd.), for which the author is most thankful.

Sri K. T. Pandurangi, Professor and Head, Department of Sanskrit, University of Bangalore (Retd.), and presently President, Mythic Society, Bangalore, has been kind enough to write a foreword to the book. It is with great pleasure that the author thanks him for his encouragement.

Professor S. K. Ramachandra Rao is gratefully thanked for all his encouragement in bringing out this book and for the nice cover illustration, which personifies Varaha incarnation of Mahavishnu re-establishing the Earth possibly signifying the geological truth of the rise of the grand Himalaya mountain by the nose-diving of the Indian peninsula.

If this book inspires the modern students of the Earth Science disciplines to evaluate and appreciate the developments in the early Indian thoughts about the rudiments of a Theory of the Earth as compared to the developments in the Western schools, the author feels amply rewarded.

Prabhava Aswayuja,
Vijayadashami,
2-10-1987.

S. R. N. Murthy
Bangalore

CONTENTS

Page No.

I. DEVELOPMENT OF THEORY OF THE EARTH IN EUROPE & ANCIENT INDIA—A CRITICAL REVIEW

1. Introduction ... 1
2. Development of geological ideas in the middle ages. ... 4
3. The age of Scientific Cosmology ... 7
4. The Pragmatists ... 14
5. The modern era ... 17
6. Nomenclature of earth in Sanskrit literature ... 19

7. THE VEDAS AND THEIR GEOLOGICAL ASPECTS

Introduction ... 25
8. The Rig Veda ... 27
9. The Vedic authorities ... 27
10. The Vedic meters ... 28
11. The subject matter of the Rg. Veda ... 28
12. The classification of the Rg. Veda ... 29
13. On some sooktas ... 30
14. The Vedic significance ... 31
15. Recognition of Directions ... 32
16. Recognition of the celestial objects ... 33
17. Description of the Sun ... 34
18. Description of the Moon ... 36
19. Some specific observations on the Sun, Moon, Planets and Nodes ... 37
20. Cessation of the Vedic growth ... 39

Page No.

21. THE GEOLOGICAL ASPECTS OF JYOTISHA
Introduction ... 41
22. The Kalpa Theory ... 44
23. The role of the earth in the cosmic cycle ... 47
24. Concept of Manvantara & Pralaya ... 49
25. Other Siddhāntas of antiquity ... 50
26. The geological aspects of the Surya Siddhanta ... 51
27. Instrumentation ... 51
28. THE GEOLOGICAL ASPECTS OF THE VEDANTIC & RELATED TEXTS
Introduction ... 53
29. The Upanishads ... 54
30. Taittariya Upanishad ... 55
31. Conclusions ... 58
32. Important general references ... 59
II. VARAHAMIHIRA'S CONTRIBUTION TO VEDIC THEORY OF THE EARTH
1. Introduction ... 63
2. Correlation of the terrestrial events with Solar phenomena ... 66
3. Correlation of the terrestrial events with the movements of the Moon ... 70
4. CORRELATION OF THE TERRESTRIAL EVENTS WITH ECLIPSES, etc.
Introduction ... 73
5. Local changes correlated with Eclipses ... 77
6. The Ten Types of Ecliptic shadows and their correlation ... 78
7. Correlation of Eclipses according to lunar months ... 80

Page No.

8. CORRELATION OF MARTIAN MOVEMENTS WITH THE TERRESTRIAL EVENTS

Introduction ... 86

9. The five kinds of Mars correlated to terrestrial events ... 86

10. Correlation of terrestrial events with the movements of Murcury ... 86

11. The seven types of movements of Mercury ... 88

12. Terrestrial events correlated with Jupiterian movement ... 90

13. Names of Yuga ... 93

14. Correlation of the movements of Venus with terrestrial events ... 97

15. Correlation of the movements of Saturn with terrestrial events ... 101

16. Additional observation by Varahamihira ... 105

17. Varahamihira's contribution to the Vedic theory of the earth—An appreciation ... 109

18. References ... 110

III. TOWARDS AN INTEGRATED COSMIC THEORY OF THE EARTH

1. Introduction ... 111

2. The Earth in relation to Universe ... 115

3. The Earth and the Planets ... 118

4. Important Principles ... 120

5. Conclusions ... 125

6. References ... 127

DEVELOPMENT OF THE THEORY OF THE EARTH IN EUROPE AND ANCIENT INDIA —A CRITICAL REVIEW

Introduction

Literature on the development of a theory of the earth is extensive and to compress the vast information in a brief article is rather unjustified. One can judge the stupendous amount of information that is spread in various publications of the learned societies in different countries the world over as indeed a fitting discourse on the earth which is really vast and varied though at the present juncture of the human history it may look shrunken due to the unprecedented progress in the fields of science and technology. Information on the study and understanding of the changes in the earth is found in different languages and indeed it may be well-nigh impossible to do justice to the subject on hand by acquainting oneself with one or more languages. However, the subject matter is so interesting that it is difficult to let go the problem, for these handicaps are eternal. Hence, an attempt is made in these pages to present the most salient features of the various concepts and theories of the earth which were developed in the course of the development of Sciences of the Earth in Europe and ancient India, purely with the aim of educating the student of the earth to appreciate the status of knowledge to make necessary preparation to further the cause and to contribute and refine the theories towards perfection.

All European ideas spring from Greco-Roman philosophy. The Mediterranean region being prone to frequent earthquakes and volcanoes, the first enquiries of the directed thinkers were pointed to their cause. Anaximenes (B.C. 544), Herodotus (B.C· 500), Anaxagoras (B.C. 480), Democritus (B.C. 460–357), Aristotle (B.C. 384–322), Theophrastas (B.C. 374–287), Strabo (B.C. 54-A.D. 25), Seneca and host of thinkers have contributed their observations on the earth history of the development of a theory of the earth. Anaximenes thought that the earthquakes were produced by the disruption of mountains when the earth–first full of water–dries up ; Herodotus believed that the gorge of Tempe was caused where the mountains had been torn asunder by an earthquake ; Anaxagoras stated that the earthquakes were caused by the descent of the surrounding ether into the depths of the earth ; Democritus said that the earthquakes were caused by the bursting of the mass of liquid within the earth, especially after heavy rains.

Aristotle recognised that the earth is spherical for its shadow on the moon during a lunar eclipse is round and its size is negligible when compared to the stellar heavens. He also believed in the four elements, viz., earth, water, air and fire, the latter three successively are compressed in the earth. He believed that the earthquakes are due to a commingling of moist and dry air within the earth. He observed that earthquakes occur most abundantly in spring and autumn which supported the views of Anaximenes. He also regarded that the earthquakes and volcanic eruptions are related phenomena. Aristotle's idea that volcanic action was due to the movement of wind imprisoned within the earth was accepted.

Theophrastas–student of Aristotle–made studies on the characters, sources and uses of more familiar rocks and minerals. Strabo described the dormant Vesuvius as it was once a volcano and had become extinct on the failure of subterranean fuel. He also describad many areas of local sinking and believed that they were due to earthquakes.

Seneca gave a vivid description of the Campania earthquake of 5th February A.D. 63. He also believed in the Aristotelian school of supposing the cause of earthquakes and volcanoes as due to the movement of wind imprisoned in the earth. However, Seneca observed that 'Though the processes below ground are more hidden from us than those on the surface of the earth, they are none the less equally governed by invariable laws'. This observation is something prophetic. He compared veins of ground water to the veins of human body.

Pliny the elder was a keen student of the earth. He became the first martyr to the cause of geological sciences when he lost his life while exploring the mysteries of volcanic action which destroyed Pompeii in A.D. 79. Pliny also believed in the movement of subterranean winds as cause of earthquakes and differed from the earlier Babylonian opinion on earthquakes and allied phenomena as due to the influence of the stars.

Based on the occurrences of sea shells in the upraised younger formations, it is mentioned that as early as 614 B.C. Xenophanes of Colophon concluded that such evidence proved periodical submergence of the dry land. This concept was supported by Herodotus, Eratosthenes and Strato. While Herodotus was acclaimed as the Father of History, Aristotle was regarded as the Father of Natural History.

Development of Geological Ideas in the Middle Ages

The development of geological thoughts during the Greco-Roman times is characterised by a recognition of the fact that the world is regulated by certain laws which are invariable and impartial in their operation since the beginning. This was considered to be a period of intellectual progress of mankind, untrammelled by any opposition from religious quarters or from popular beliefs. This was a period when old religion of classic paganism was losing hold on the people replaced by the introduction of scientific philosophy due to the new freedom of thought.

Towards the end of the Middle Ages when the progress was resumed after the downfall of Roman empire, says Andrew Giekie (1905)—'a spirit of intolerance had arisen from which Antiquity had been free'. The onset of barbarian destruction arrested the slow and steady development of the geological thoughts. After the Arabs appeared on the scene, the inquiries into the realms of the nature were resumed from about the middle of the 8th century. Avicenna (Ibn–sina, 180–1037 A.D.) translated the works of Aristotle into Arabic. The old Xenophanean deduction that occurrence of sea-shells in rocks on dry land indicated that the land experience periodical submergence was current amongst men of learning. But such ideas were against the belief of Holy Bible, and invited the risk of persecution as heresy, for the Bible stated that the land and sea were separated on the 3rd day of creation and animal life did not begin until the 5th day ; also, the deduction that the earth was older than by 6000 years to account for geological processes ran counter to the Holy Writ.

Then there was a school of diluvialists who did not want to antagonise the Church but at the same time tried to fit the facts of geological observation into the frame of the Holy Writ. This theory was rather supported by the formation of a volcanic hill–Monte Nuovo–nearly 500 feet high in two days on the shore of the Bay of Naples in 1538 A. D. While such formation could take place within short time before our eyes, there was hardly any fact to support the concept of any longer age to be accepted for the formation and development of the earth as a whole than what was mentioned in the Holy Writ.

Andrew Giekie (1905) observed that 'During the sixteenth, seventeenth and a great part of the eighteenth centuries, the controversy over organic remains and the part played by the Flood, while keeping alive the interest in the subject, undoubtedly hindered the advance of rational conceptions of the fundamental facts of geological history'. From the time of Leonardo da Vinci (1452–1519), the discussion was revived. Fracastro, Cardano, Mattioli and Fallopio all were under the influence of Aristotelian thought and did not believe in the Deluge theory. According to Giekie 'Aristotle had decided against any universal flood, and the authority of this philosopher was then as potent as that of the Holy Writ'.

The fossil shells contained in mineral collection of Pope Sixtus V at the Vatican was considered by Mercati as mere stones that had assumed their shape under the influence of celestial bodies. Another similar collection at Verona was considered by Olivi as a mere sport of Nature. But Cesalpino looked upon the fossil shells as organisms that had been left by the retiring sea, and had been turned into stone by the petrifying influence of the surrounding rock. However, Majoli thought that fossil shells on the land were ejected by submarine volcanoes from the sea-floor.

The origin of fossil shells was an interesting problem and many Italian thinkers were advancing their views on the subject. At that time Nicolas Steno of Copenhagen presented a treatise in 1669 in Florence wherein he perceived that the strata of the earth's crust contain the records of a chronological sequence of events and that the history of the earth must be deciphered from them. Vallisneri at Padua wrote on the origin of springs.

In 1681 Thomas Burnet published his sacred Theory of the Earth in England. The book was meant to support the orthodox school of thought. Probably the treatise was first of its kind on the theory of the Earth. From this onwards numerous books on theory of the Earth appeared in Europe. They were all based on cosmogonic presumptions. Of the same category may be mentioned the following works :—

New Theory of the Earth by Willium Whiston–1696

Essay towards a Natural History of the Earth by John Woodward–1695.

Robert Hook (London, 1705) published his works on the subject and was opposed to the orthodox school, while John Ray was rather undecided on his view between orthodoxy and science. Martin Lister (1671) suggested that volcanic eruptions might be due to the subterranean decomposition of iron pyrites. He also proposed the preparation of geological maps.

The Age of Scientific Cosmogony

The period between the middle of the seventeenth century and middle of the eighteenth century may be called the Age of Scientific Cosmogony. It may be recalled that the Royal Society of London for Improving Natural Knowledge was formed during the period in 1662 by Charles II with the grant of a Royal Charter of Rights and Privileges. According to Ronan (1964) the Fellows of the Royal Society were 'for the most part men who were forging ahead with the new experimental approach to knowledge of the natural world. They insisted on the importance of verifying theories of every kind by experimental evidence, and had broken away completely from the older view of turning to ancient authority as the test of any new idea. Their motto, **Nullius in Verba,** which has been freely translated most aptly by Professor E.N. da C. Andrade, himself a Fellow, as "We don't take anybody's word for it", succinctly expresses their approach to Natural knowledge. Though many societies existed in various countries and contributed to the advancement of knowledge about the earth, the contributions of this society was something extraordinary. Newton, Descartes, Leibnitz and many others made fundamental contributions to the advancement of our knowledge of the earth and the universe, especially supporting the ideas of Galileo and Copernicus, Tycho Brahe and Kepler.

The idea of a disc-like earth floating on water is as old as Babylonian thought ; such an earth in the centre of a 'Spherical Universe' was attributed to Homer and followed by Pythagoras with the modification that the earth is also a sphere. Plato, a student of Socrates, also accepted the Pythagorean idea of a stationary spherical earth at the centre of a spherical universe. The same idea was held by Aristotle. With the advance of knowledge in mathematics and astronomy, and also with the steady observations on the movements of the heavens and the earth, certain basic facts about the earth were established. In the meanwhile, Eratosthenes (240 B.C.) established the circumference of the earth by his knowledge of geometry and early astronomy. While Applonius propounded a theory of motion of planets in epicycles, Hipparchus is known for his discovering the precession of equinoxes of the earth. Ptolemy propounded the geocentric theory of the universe in the second quarter of the second century A.D. This idea of geocentric theory of the universe ruled till the Copernican heliocentric theory was established in the 15th century A.D. In the latter half of the same century, based on Tycho Brahe's observational records Kepler established his laws of motion of planets. During the same period Galileo supported the Copernican doctrine of a moving earth and established his laws of acceleration which later helped formulation of the theory of gravitation.

Amongst the early astronomers who gave thought to the origin and evolution of the earth is possibly Descartes. He in his book "Philosophe Principle" (1644A.D.)gave an exposition that the various planetary bodies were originally glowing masses like our sun. The earth, accordingly, possessed a nucleus of incandescent self-luminous matter; the middle zone is composed of an opaque solid substance which was at first liquid in condition; the outer zone is made of solid crust. He explained at length the disposition of various planets around the sun and gave certain ideas on the formation of volcanoes and earthquakes due to the escape of internal heat of the earth admixed with volatiles. Leibnitz developed the theory on the lines of Descartes and said that (Acta Eruditarium, 1693 A.D.) the first mountains were formed by the irregular development of the early crust and the erosion of these parts caused the formation of sedimentary rocks. His ideas repeat those of Descartes in explaining the volcanoes and earthquakes. He, however, distinguished the crystalline form of minerals from those of fossils and questioned that "whether it was not to be presumed that with the great changes which the earth had undergone a great many animal forms had been transformed?" This question appears to be a precursor to the ideas of Darwin. More of his observations are contained in his book 'Protogea' published in 1749.

In the Age of Scientific Cosmogony probably the last theory of the earth was presented by Buffon in his 'Natural History' (1749). Buffon thought that any true theory of the earth must trace the history of the planet from the beginning which is intimately linked with the evolution of the solar system. In his book 'Epochs of Nature' (1778) Buffon appears to have attempted to form some ideas in order to bring in the history of the earth in Six Epochs based on certain experiments with globes of cast iron. He does not seem to have succeeded in getting any result but has been able to interpret the six epochs of the earth he conceived with six days of the Holy Writ. They are given below :

First Epoch	The materials of the earth torn from the sun in the form of molten mass assumed an oblate spherical form under the influence of motion ; cooling from outside gave rise to the crust, hydrosphere and atmosphere ; the period was 2936 years involving incandescence before consolidation and later 35,000 years for life to originate.
Second Epoch	Consolidation of the molten globe and forming of uneven surface with crust made of granite gneiss, etc., ancient crystalline rocks.
Third Epoch	This period covered some 20,000 years. During this period the vapours condensed and formed boiling oceans in the beginning with a thickness of the water sheet of nine to twelve thousand feet and accounted for rapid erosion of the land surface which supported thick forests ; the oldest species which are now extinct flourished in the oceans and their fossils were found in the rocks formed of the products of erosion.
Fourth Epoch	This period accounted for another 20,000 years. During this epoch the oceans

	reduced in their level to the present one due to much of it being percolated through cracks in the basin ; forests of the lands were swept and transported into the earth's interior which on mixing with the internal heat caused volcanoes; the volcanoes are surrounding the ocean borders for the same reason ; after the cessation of much volcanic activity the terrestrial animals came into being.
Fifth Epoch	This period accounted for the happenings during 55,000 to 60,000 years after the origin of the earth ; this period was calmer and witnessed the advent of pachyderms in the northern parts of the planet.
Sixth Epoch	10,000 years before the present time, during this epoch the old and the new worlds got separated ; this submergence caused isolation of Greenland from Europe, Canada and Newfoundland from Spain, etc.

Buffon recognised a Seventh Epoch in which he conceived Man's supremacy on the earth. He foresaw the extinction of our globe due to gradual refrigeration after 93,000 years. He believed that the plants and animals have an existence of some 1,32,000 years.

This theory of the earth by Buffon appears to be far advanced but ingenious version of a theory of similar nature which was authored by Beniot de Maillet and published posthumously in 1748. He presented this idea as though from the mouth of an Indian philosopher Telliamed (his name in reverse), according to Giekie (1905). It can also be seen that Buffon perhaps desired to give a scientific or imaginative explanation to the six days of creation described in the Holy Writ in order to prove his faith in both science and religion. It is difficult to make out why the western scholars desired to put their ideas in the mouth of an Indian philosopher (as Maillet did) and the epochal scheme of the life of the earth by Buffon seems to compare with some of the Kalpas of Hindu Almanac (Murthy, 1982). It may be recalled that during the Alexandrian times and Middle Ages many Hindu scholars from India were commissioned to the west to introduce their schools of astronomy and philosophy. Inspired probably due to their observations and with added experience of the Mediterranean region the masters of the continent continued the chain of inquiry. While the western schools continued thus into the realms of knowledge, the oriental schools were disrupted due to many historical invasions which hindered their progress with incalculable damage. According to Ronan (1964)—'In mathematics, however, they (Arabs) took a number of steps forward, especially by introducing the **Hindu system of writing numbers** in the development of algebra and in trigonometry. The significance of the use of Hindu numerals, or Arabic as they have come to be called, can really be appreciated if we try even the simplest of sums, for example, an addition of, say 7, 78 and 779 and then repeat it with Roman numerals (VII, LXXVIII and DCCLXXIX); indeed it is no exageration to say that if the encumbrance of Roman numerals had remained, mathematics would never have progressed as it subsequently did'. The Arabian interaction did much to popularise the Hindu mathematics in the continent. But it has not been possible to note any similar communication prevailed in those days specially in regard to the oriental ideas about the origin and evolution of the earth.

The Pragmatists

Till about the 16th century the concepts about the earth in the continent are more or less speculative with certain amount of observations to support. With the institution of the idea by Copernicus that the earth is moving and not stationary and is not in the centre of the universe but it moves around the sun through his book 'De Revolutionibus' (1543) more and more observational records of early astronomy took shape specially by the works of Tycho Brahe and Kepler. Based upon the data collected by Tycho, Kepler could advance his well known laws of planetary motions and his book 'The Harmony of the Universe' (1621) is acclaimed as one of the most outstanding works which influenced many later scientistss. Galileo inspired by the ideas of Copernicus, continued the chain of investigation into the motions of the earth and published his famous book 'The Sidereal Messenger' in 1610. It is stated (Ronan, 1964) that Galileo believed in that the

'Bible shows the way to go to heaven, not the way of heavens go'. His book 'Discourses on Two New Sciences, of Mechanics and of Motions' published in 1638 is stated to contain the first truly scientific laws of motion of the earth. With the publication of the monumental work by Newton entitled 'The Mathematical Principles of Natural Philosophy' in 1686, the universal theory of gravitation was established and the relationship that the earth bears with the universe was recognised.

While the cosmological aspects of the earth were thus being advanced by students of astronomy, the terrestrial aspects were emphasised by students of mineralogy like Guettard who prepared the first geological map and published at the Academy of Sciences in Paris in 1751. Amidst the dreary discussions on the cosmological aspects, this publication merited such a fundamental appreciation of the materials of the earth like distribution of rocks and minerals that the exercise of preparing the geological map of the entire earth has become the main purpose of major organisations now to unearth the economic mineral deposits by a rational study. He is stated by Geikei (1962) to have observed in his text that 'If nothing can contribute more towards the formation of a physical and general theory of the earth than the multiplication of observations among the different kinds of rocks and the fossils which they contain, assuredly nothing can make us more sensible of the utility of such a research than to bring together into one view of those various observations by the construction of mineralogical maps'; since the term "Geological" was yet not in currency, the name mineralogical was put up.

With advances in research on the origin and evolution of basalt by Desmarest through his Memoir of Academy of Science, Paris, in 1774, further developments of geological mapping in parts of the continent by Strachey, Lehmann, Fuchsel and William Smith and others and by the concepts of the school of Neptunists led by Werner some fundamental concepts about the earth were established, though many required considerable refinement in later years.

The most important contribution by the school of pragmatists in the period is that of Hutton. Hutton published his work 'Theory of the earth, with proofs and illustrations' in 1795. This book inspired the plutonists as opposed to the older school of neptunists. Hutton is known for the statement that the 'present is the key to the past' and his down to earth views are well quoted by Geikie (1962) thus in the interpretation of nature 'no powers are to be employed that are not natural to the globe, no action to be admitted of except those of which we know the principle, and no extraordinary events to be alleged in order to explain a common appearance. The powers of nature are not to be employed in order to destroy the very object of those powers; we are not to make Nature act in violation to that order which we actually observe, and in subversion of that end which is to be perceived in the system of created things. In whatever manner, therefore, we are to employ the great agents, fire and watar, for producing those things which appear, it ought to be in such a way as is consistent with the propagation of plants and the life of animals upon the surface of the earth. Chaos and confusion are not to be introduced into the order of Nature, because certain things appear to our practical views as being in some disorder. Nor are we to proceed in feigning cause when those seem insufficient which occur in our experiences."

These observations by Hutton brought the airy and cosmogonic thinkers to the hard ground truth to look to the geological history with the present data. This principle which was later presented by Lyell as 'Principle of Uniformitarianism' gained momentum and helped Lyell to formulate the 'Principles of Geology' which created the ground for modern geological discipline amongst various branches of science. With the formation of the Geological Survey by Great Britain in 1835, geological progress later has been incessantly marching for wider and deeper understanding of the earth in its totality.

The Modern Era

It would be difficult to summarise the developments which have taken place in the advancement of geological sciences since the appearance of the book 'Principles of Geology' by Lyell in 1833 and the establishment of the world's first geological survey in Great Britain. The systematic geological mapping followed by stratigraphical, petrological, mineralogical, chemical, structural, etc., studies of rocks and rock formations, fossils and minerals have made the geological sciences advance closely pacing with the advancing frontiers of other branches of modern science. However, our knowledge of the earth is, yet far from being recognised as even adequate to formulate a reliably sound theory of the earth by which we can determine with certain amount of confidence its behaviour even to predict events in short future. Eruptions of volcanoes, manifestation of earthquakes, onset of rains, movement and submergence of lands, occurrences of storms,landslides and erosional patterns, etc., etc., are yet hard exercises in the school of the earth. There exists no satisfactory theory of the earth which ventures these aspects—though location and identification of new mineral occurrences, to support the industrial base has been very successful on the concepts which have so far been developed.

The scientific study of the origin of the earth and the planets of the solar system, as a problem of astronomy and astrophysics, has been much advanced since the time of Kant and Laplace, Chamberlain and Moultan, Jeans & Geffrys, Van Wizekar and Bondy. Hoyle and others have advanced modern theories notwithstanding the advances made in the field of astronomy.

On the evolution of the earth, theories like those of origin of life and its evolution by Darwin, geochronology and concepts of Plate Theory since the time of Wagner's Theory of Continental Drift, etc., have made much contribution.

However, students of the earth are yet to solve the problems of volcanoes and earthquakes. With the theories on the origin of mountains, considerable data is yet to be marshalled. The geodynamic concepts are just being understood.

Many of the concepts about the interior of the earth are only speculative. Deep shock earthquakes and high P-T technolocy have given some data but mostly insufficient to make any reasonable prediction. Geothermal, geomagnetic, palaeomagnetic, geo-electrical, etc., studies are still inadequate. The concept of time, the relevance of general theory of relativity, etc., are yet to be ascertained.

With such an array of just adequate or inadequate data, the formulation of a theory of the earth is difficult. Even then it is necessary to have such a theory for testing. As Schindegger (1963) has observed that almost all the theories of the earth which exist are only partial and do not help much in the development of a sound theory of the earth. But this would give an opportunity to take stock of the data available and to identify the areas of further research.

Nomenclature of the Earth in Sanskrit Literature

The earth is understood to be the representative of the four fundamental elements of Nature, *viz.*, space, air, fire and water and is considered as the fifth fundamental element, hence the name 'BHU' since the fundamental elements are called 'Pancha Bhootas' in Sanskrit language. The earth has been understood, thus to be the visual representative of the universe, hence named as 'Vishwambharaa'. The vedic students called the earth by names like 'Maheedharani', for it is enveloped by atmosphere, 'Jalashayinee' for it is isolated by the oceans. They also observed that the earth contains gold, an element in its native state which most attracted them, hence named the earth as 'Hiranyagarbhinee' meaning that one who contained gold in her womb.

Later Sanskrit literature was studded by numerous and meaningful names of the earth. By the time of the author of 'Naamalingaanushaasanam' (a well known Sanskrit Lexicon), some 38 names were in use for the earth. They are listed below only to indicate the wealth of the language :

BHU
BHOOMI
ACALAA
ANANTAA
RASAA
VISHWAMBHARAA
STHIRAA
DHARAA
DHARITREE
DHARANI
KSHONEE
JYA

KAA'SHYAPEE
KSHITIHI
SARVAMSAHAA
VASUMATI
VASUDHAA
URVEE
VASUNDHARAA
GOTRAA
KUHU
PRITHIVEE
PRITHWI
KSHMAA

AVANI
MEDINI
MAHEE
VIPULAA
GAHWAREE
DHAATRI
GOURI
ILA
KUMBHINEE
KSHAMAA
JAGATI
RATNAGARBHAA

BHOOTADHAATREE
ABDHIMEKHALAA

Some of the names are derivatives of shorter forms like Vasundharaa from Vasudhaa or Vasumati as also Dharitri from Dhaatri and Dharani, etc., but names like Achala meaning that is 'without motion' is scientifically incorrect but for the man to start acquainting with the earth at local places, the earth appears to be mostly not moving. Same description for the name 'Anantaa' also, for, you may circumnavigate the earth but it appears to be without end. The earth is contained with the six kinds of tastes, recognised in the vedic discipline of medicine, hence called 'Rasaa' meaning that one who contains the 'Shadrasas'.For all purposes, the earth is relatively and locally 'stable' hence called 'Sthiraa'. The name 'Kaashyapee' appears to mean that the earth is originated from the sun who is shining or with 'Prakaasham'. Most of the other names are used chiefly in literature with relevant context of simpler notations. The earth is considered to be mercy personified, hence called 'Kshamaa' and bears all kinds of ill acts against, hence addressed as 'Sarvamsahaa'. Since the earth is noted to contain the element of matter, which is called 'Vasu' the name 'Vasudhaa' is used and the one containing the mountains and hills is 'Dharaa'. Since the earth governs all peoples it is called 'Avani'—one who protects. The earth is noted to have been rendered in this form by a mythical ruler 'Pruthu' hence the name 'Prithwi' or 'Prthwi'. Because of plenty of materials of life the name 'Vipulaa' is used. 'Gahwara' means caves and it may also indicate the early acquaintances of the human being on the earth through his cave dwellings, hence

'Gahwaree'. Kumbhini name is literally agreeable since the earth is in the form of a kumbha or pot. 'Ratnagarbha' means one who contains gems in the womb. One who wears the five fundamental elements called the panchabhootas is addressed as 'Bhootadhatree' and who represents the whole universe which is eternally changing is 'Jagati'. Abdhimekhalaa' means that one who has the oceans as the waist-ornament. This has great significance from geological point of view. While the name 'Kuhu' is related to the formation of the earth from the space or sky which is called 'Kham', the names Kshones, Kshitihi are to do with the consideration that the earth contains an axis, which is called in Sanskrit 'Aksha' or 'Ksha'. 'Jyaa' means the wire of bow and it may mean that the earth is having Jyaa since it is curved like a bow everywhere. The earth is also called 'Urvee' meaning that one who is widespread. 'Gouree' may mean the places on the earth which are white due to the vast deserts or the large caps of snow or a body with weight. 'Mahaan' or large is 'Mahee', 'Ila' a proper name ; 'Medini'—joy giver.

These conceptual nomenclatures of the earth is very important from the point of view of later developments specially during the scientific era. That the earth is like a pot is the basis for the consideration of a Gola, a term used in English language as 'Globe'. The shape, content, relation to the universe, evolutionary pattern as per their philosophy, quality, etc., have been described of the earth by these terms. The earth is female in gender spoken in Sanskrit literature. This concept has the most fundamental basis of the material manifestation of the earth of the five fundamental elements of nature, the Nature having been considered with feminine quality.

Most of these concepts have great relevance to modern geological understanding. The earth is also called in the Vedic Bhusookta as 'Saavitri' meaning that one who is derived out of the sun. The word 'Samudravati' qualifies the earth to contain the seas. The earth is also called 'Dhanurdharaa' meaning that 'one wearing the bow' and it is already described in the name 'Jyaa' which compliments this meaning. Maadhavi, Vishnupatni, Sarvasiddhi, Accutavallabhaa and other names are connected with myth. Since life in its multidimensional aspect originates on the earth the name 'Prasoovri' is used. In this context, it is very difficult to evaluate fully the meaning of 'Avani' as meaning 'Protector', for, in the vast expanse of the universe, the earth is the only planet known even to this day were life exists and being protected from the destruction of cosmic rays. The concept of 'Avani' as the earth who is the protector of life from total destruction of cosmic and other deadly rays of the universe is immensely justified. Similarly the significance of the term 'Saavitri' meaning that the earth is formed of the sun is more than scientific in its purport.

The terms used in the vedic hymns like Hiranyagarbhini, Vaayumati, Jalashayani, Maheedharani, etc. indicate the nature of understanding of the vedic students about the earth, specially as the container of the mountains and oceans as well as ore minerals. Of course, the vedas are the oldest texts that any civilisation knows, but they contain ideas more advanced than the early man on the earth. The broad features of the earth could be recognised by the vedic students and the students of Vedanga Jyothisha, i.e., vedic astronomy, recognised many of the physical aspects of the earth like the shape, size, revolutions, etc., in addition to their observations on the other members of the solar family specially in the background of starry heavens. The later siddhantas improved upon the early observations from time to time and the geocosmic theory was provided with a grand and stable foundation.

THE VEDAS AND THEIR GEOLOGICAL ASPECTS

Introduction

The vedas are the ancient Indian compositions of knowledge, especially of Nature and its aspects, in a language which is somewhat different from Sanskrit. The word 'veda' has its root in 'vid' which means to 'know'. At present four vedas are recognised and named as follows :

1. Rg Veda or Hotr Veda
2. Yajur Veda or Adhwaryu Veda
3. Saama Veda or Udgaatr Veda and
4. Atharvana Veda or Brahma Veda or Bhaishajya Veda or Kshatra Veda.

The Atharvana Veda appears to be a later veda for, about the time of Amarasimha, the author of Naamalingaanushaasanam (Sanskrit Lexicon) its mention has not been made. He observed that :

"Striyaam Rk Saama Yajushee iti Vedastrayastrayee" which suggests that only the first three vedas were recognised by the learned in his time. Even the well known hymn of Gaayatri is named so far, it is addressed to the sun who is sung by the 'Three Vedas'.

An examination of the three vedas will also make it clear that the Saama Veda and the Yajur Veda are but different versions of Rg Veda with some modifications Since the priest who pronounces the Rg hymn is called 'Hotr' it has come to be known as 'Hotr Veda'. The same Rg is modified for purposes of sacrifice and it is spelt in the modified form by the priest called 'Adhwaryu',hence the name of the veda as'Adhwaryu Veda'. The priest who uses to sing the same Rg is called 'Udgaatr' and the name 'Udgaatr Veda', thus meant 'Saama Veda'.

The classification of the vedas as above is ascribed to Veda Vyasa (the classifier of the vedas). Perhaps during the time earlier to Veda Vyasa, the vedas were only of Rg group. Hence, the Rg Veda has precedence over the other vedas and hence is known to be the earliest.

The Atharvana Veda did not get recognition earlier for, it appeared to the vedic seers to have contained aspirations with most materialistic approach to life. However, most of the contributions made to positive science by the ancients originated from the Atharvana Veda, including the vedic medicines, hence they were also addressed as 'Bhaishajya Veda'. Perhaps Dhanurveda' (Archery) was also a part of Atharvana Veda, hence the name 'Kshatra Veda'' so useful for Kshatriyas or rulers.

The Ṛg Veda

Rg Veda is a compendium of hymns specially attributed to the description of various aspects of nature. They represent the earliest known compositions of human mind.

A group of hymns describing a particular aspect of nature is called 'Sookta'. Rg Veda, in all, contains 1028 Sooktas including the 11 Khila Sooktas (obsolete or degenerated). 10,600 hymns make up the whole of Rg Veda and 4,32,000 letters (Aksharas) are known to have gone into the Rg Vedic compositions.

Before any script was invented, the vedic hymns were transmitted by way of oral learning of the hymns, by teacher to the student. Since they were preserved in that fashion they were called 'Shrutis' or of 'Shabda Pramana', i.e., the ones which are 'heard'; hence 'evidences in sound form'. (Vedas were orally transmitted by the teacher to the pupil).

The vedas were also called 'nigamas' since they defined a "clear path to know the Real".

The Vedic Authorities

The vedic school does not admit any human authority. They believe that the Vedas are 'eternal' and they were not authored by anybody (Apourusheya). Although the vedic truths are understandably 'eternal', their perceptions by seers is very clear from every hymn. Gritsamadas, Vishwamitras, Vaamadevas, Atris, Bhaaradwajas, Vasistas, Kanwas are known to have perceived most of the Rg Vedic truths.

Seers like Kashyapa, Gautama, Jamadagni, Bhrigu, Garga, Naarada, Medhatithi, Hiranyasthoopa, Hiranyagarbha, Sindhudweepa, Deerghatamas, Virupa, Skanda, Budha, Narayana, Mudhucchanda, Vrishaakapi, Ririmmitha, Yama, Angiras, Shunashyepha, Shakala, Bashkala, Brahma, Vishnu, Maheshwara, and many many others have contributed to the growth of the vedas by perception.

The Vedic Metres

The Rg Vedic compositions are set to well established metres like Gaayatri, Anushtup, Jagati, Atijagati, Trishtup, Ushnik, Pankti, etc., etc. They are simple and most elegant and produce a sober effect on the mind when meditated as per instructions of the Guru.

The Subject Matter of the Rg Veda

The subject matter of the Rg Veda, as has been already mentioned, is the description of various aspects of Natural Phenomena. They give us an understanding about the earlier human nature interactions known to mankind.

The hymns are most impersonal and absolutely secular and generally personified. The activity of the various natural phenomena is described in an appealing manner. The subject of the compositions may be the forests, the rainfall, the sunrise, the glow of fire, the moon and moon-lit-night, the night, the burning of fire, the mirth of evening, the starry heavens, the whistling wind, the storm, the changing seasons, the law underlying the seasonal changes, the wonder of creation of the universe and so on.

The Classification of the Rg Veda

The Rg Veda is classified either into Ashtakas or into Mandalas. The Ashtaka classification appears to have no basis except for facilitating the entire veda in a chain manner (chandas) for learning by heart. The Mandala classification, however, presents some kind of an evolution in the vedic compositions.

The Ashtaka classification involves the division of Rg Vedic matter into 8 Ashtakas and each Ashtaka into 8 Adhyayas with several Vargas composed of many Rks. The Mandala classification divides the Rg Veda into 10 Mandalas with each Mandala consisting of several Anuvakas or Sooktas. Each of the Mandalas has been attributed to the perceptions of a particular school of Rishis, as givan below :

Mandalas	*Rishi Kulas*
Second	Gritsamadas
Third	Vishwamitras
Fourth	Vamadevas
Fifth	Atris
Sixth	Bharadwajas
Seventh	Vasishtas

Hence, they are called "Kula Mandalas".

The Eighth Mandala is attributed mostly to Kanwas and the First and the Tenth Mandalas to many Rishis describing the wind and the moon, i.e., Pavamana-soma.

The hymns are practised by way of Pada (word), Krama (step by step), Jata (chain form) and Ghana (part or sectional). The sound is adjusted as swara, udatta, anudatta and pluta. By this way a practice of the Rks has enabled them to be preserved to this day.

On some Sooktas

On waters :

The river waters are ceaselessly working and cleaning (the surface of the ground); they flow in channels and valleys; they flood and flow into the seas. There are waters from the rain and from the ground, they are sparkling and the (cleaning agents).

On the earth :

The earth is containing hills and forests, the snow clad mountains and is decorated by the variegated auroras at the poles.

On the natural law (Varuna)

By the cosmic law the earth is spread like a carpet under the sun, the winds are held in forests, the fire is set in water, the sun in the sky and juices in the mountain, the cloudy cups are tilted causing rains, the flow of the rivers do not overbrim the sea. . . .

On creation :

In the beginning of the Kalpa was the golden sun, then the earth was created. The snowy mountains and the rivers (and all other activities) followed the law.

The Vedic Significance

Although the vedic hymns seem extremely simple and poetic, they contain a great deal of observational data. The majestic, melodious songs of the vedas lead to clear interpretations of some of the profoundest principles of truths. This can be exemplified by one or two facts, the relevance of which will be borne later in describing the theory of the earth.

Those who practise the vedic way of life, believe in repeating the well known 'Gaayatri Hymn' 108 times, thrice a day. The hymn was perceived by Vishwamitra Rishi and the hymn is attributed to the sun with a prayer to sharpen the mind. The prayer is done on the eve of sunrise, at mid-day and the sunset daily. The significance of the number of repetition of the hymn is ascribed to the relative size of the earth and the sun by their diameter. It can be seen that the diameter of the earth is about 8000 miles and that of the sun is 108 times the diameter of the earth, i.e., about 8,64,000 miles. Taking the earth as unit of astronomical measurements appears to be as old as this concept. Vishwamitra has been said to be a great astronomer of his time. The human body represents the earth with all its constituents in various proportions and the sun representing the starry energy, their relationship is described by this subtle law.

The Rg Veda has already been mentioned to contain 4,32,000 letters. This number again is one of the most significant numbers used in the vedas. 4.32 million solar years (10 times the number of letters) make up one Mahayuga, a thousand of which is said to be a Brahma dina (a day of Brahma) equivalent to one creation.

Recognition of Directions

On observing the sunrise and sunset they were able to recognise the East and the West directions respectively and referred to them as Indra and Varuna. The South and the North directions then were called the Yama and Kubera. Further sub-directions are as follow :

South East = Agneya
South West = Nairutya
North West = Vayavya
North East = Ishanya

The bearing would be complete further on fixing the position with reference to the direction below called 'Adhah' and above called 'Oordhwa'.

It is difficult to make out why they called the directions by such names. The word Indra was also used to mean the principle causing the rains and also the pole. Varuna, as has already been said, is suggestive of the principle on which the celestial bodies are moving and the seasons take place. Similarly, the reason to call the south as Yama and the north as Kubera is not very clear. However, the direction S–E to be addressed by them as 'Agneya' may suggest that some kind of disposition of volcanoes with reference to their place of occupation, as also the direction N-W as Vayavya the disposition of winds with reference to their place. N-E direction was called 'Ishanya' and suggests some concern to Shiva worship and 'Nairutya' referring to S-W indicates perhaps the area by certain demoniac forms. Thus the Vedic people could, by this method of bearing, establish locations.

Recognition of the Celestial Objects

After acquainting the surrounding natural environment, the Vedic seers made uncanny observations about the heavenly bodies which attracted them by their movements. Description of the firmament is having a sense of eternality about the Vedas. In addition to the descriptions of the sun and the moon, they recognised jupiter, venus, mercury, mars, saturn and also certain very sensitive positions in the ecliptic which brought out the eclipses under the name 'Swarabhanu' and 'Kethu'. They made observations on the starry path of the heavenly bodies and sang hymns.

As has already been indicated, a number of sooktas are devoted to the observations of the sun and the moon. The hymns on the closer heavenly bodies are rather rare and on those of stars still rare. In the starry path of the ecliptic, they recognised 27 groups of stars as given below :

Ashwini
Bharani
Krittika
Rohini
Mrigashira
Aridra
Punervasu
Pushya
Aslesha

Makha
Pubba
Uttara
Hasta
Chitta
Swati
Vishakha
Anuradha
Jyeshta
Moola
Purvashadha
Uttarashadha
Shravana
Dhanishta
Satabhisha
Poorvabhadra
Uttarabhadra
Revati

Nomenclature of these star groups, again, is not very clear excepting that the system was based solely on their observational results. However, their extant in the ecliptic is certain and this standard reference frame has been considered for all events to be indicated in later sections of their work.

Description of the Sun

The sun has been the most fascinating subject of the Vedic seers. It has been described profusely in superlative terms by all the three versions of the Vedas, hence, Vishwamitra instituted the 'Gaayatri' hymn, which is the epitome of the entire Vedic achievement. Vedic seers were simply amazed about this 'Golden Shield' and their description of the sun as the 'Soul of the Universe' (Soorya aatma jagataha tastushascha) is something which is thrilling. The onset of the sun on the eastern horizon was considered by them as something extraordinary as also the dawn, the day and the sunset. The supreme light which made their day did receive nothing but their praise.

The apparent motion of the sun was realised by them and they observed that the sun never sets or rises.

The sun is thought setting on reaching the end of the day but he only causes night here and the day below (the other part of the earth). When he is thought to be rising in the morning after reaching end of night, he only causes day here and night below. This concept is very clear in Aitareya Brahmana.

The Vedic descriptions of the sun are given in the Soura hymns and also in extended forms in the Maha Soura. The Vedic prayer in the morning, mid-day and in the evening is only to the sun with a request to keep the mind alert and energetic (sharp). The significance of the number of repetition of the 'Gaayatri' has already been described.

The sun is described as being carried over by the Kethus (and other closer heavenly bodies mentioned earlier). He is described as the eye of the universe. He is treading the starry path and is making his presence felt by his fiery flames He has been most exalted and praised with highest esteem, for, he happens to be the cause of origin, existence and end of all things. The sun is described to be riding a chariot of seven horses (of seven colours of VIBGYOR?) He is the lord of all stars, and he causes life on the earth to attend to the day. Moving to the north he is requested to cure the diseases of heart. He is also described as the most artistic of the heavenly bodies (the perfect bodied) and is the eye of Mitra, Varuna and Agni. He causes dawn, evening and night. He is also the cause of many many forms (terrestrial).

Description of the Moon

Perhaps next only to the sun, moon has been described by Vedic seers in their grand compositions. As has already been mentioned, the section Soma-Pavamana contains most of the descriptions of the moon. Moon, though lit by the sun, is not blazing and burning. He is the light in the night and is pleasant. His waxing and waning is most proverbial. He is the lord of herbs. He also treads his starry path like the sun. Both the sun and the moon move in different circles or 'chakras'. This is beautifully described in the "Suryasavitri Sookta" as follows :

"By the eternal law the earth is held up (on its path) and the sun on his heavenly path. By the same law the sun and moon are enshrined in their disposition. By the moon, the sun and stars are strengthened and the earth is made great. The moon goes through the stars and he is thought to be the container of herbal juice who gives them to herbs. The wind is protected by the moon through the months. He is the companion of the sun. The Ashwins (the start of the starry path) made three paths. One path was for Brahma (Rtu or the Law), the other was for the sun. (The third one for the moon). Both the sun and the moon are playing hide and seek game in the heavenly path moving from east to west, as children of the heaven = (POORVAA PARAM CARATO MAAYAA TAU SHISHOO CREELAN. TAU PARIYAATO ADHWARAM). The moon is getting newer and newer by successive births and daily moves past kethu and dawn = (NAVONAVO BHAVATI JAAYA-

MAANO ANHAMKETHURUSHASAAM ETYAGRAM). This moon is directed in the starry path by the sun and to go to each starry mansion, and make them enliven" etc., etc.

Although the meaning of the Vedic hymns appears to be simple, they are not so and make the reality underlying the statements most difficult to understand. These observations, though based on the Vedic authority, are the earliest available, they suggest that there should have been yet earlier observations which are not available to us now. As already indicated the basis of starry nomenclature and their exact identification are yet shrouded in mystery. The above description of the movement of the sun and the moon playing the hide and seek game in the starry path is something most natural and appear to be well advanced in human understanding. They give us an impression that the Vedic seers were aware of the several circles in which they were moving and the statements are difficult for clear interpretations since much of astronomical knowledge is infused in them.

From these and many other statements of the Vedas it can be made clear that the Vedic texts that are available to us now are not the earliest, but already advanced ones and much has been left as 'khila' or 'degenerated' by the time the present texts were finalised.

Some Specific Observations on the Sun, Moon, Planets and Nodes

Apart from Vishwamitra mentioned earlier, the solar studies appear to have been made extensively by many other Vedic perceivers. Kashyapa stands out foremost amongst them, as also Hiranyastoopa. It is given that the sun came into existence or formed in the zodiacal arc of star Krittika. It is difficult to say how they could arrive at such a conclusion as that. Similarly, selenological studies appear to have been carried out by Gautama, as well as Atri. The moon is mentioned to have formed in the zodiacal arc of Uttarabhadra star. Mars is mentioned to have formed in the zodiacal arc of Mrigashira star and martian studies have been made by Viroopa and Bharadwaja seers. Mercury has been studied by Atri and Angiras and has been stated to have formed in the zodiacal arc of Poorvabhadra star. Observations on jupiter have been made by Gritsamda and Angirasa seers and it is mentioned to have formed in the zodiacal arc of Bharani star. Seers Bharadwaja and Bhargava have made studies of venus and accordingly venus is said to have come into existence in the zodiacal section of Jyeshta star. In the zodiacal section of Swati star saturn is mentioned to have formed and studies of saturn have been made by Ririmmitha and Kashyapa seers.

The moon's nodes were described as Swarbhanu (Rahu = Dragon's head; and Kethu = Dragon's tail) and attention to these sensitive points was given even as early as the Vedic period. Swarbhanu has been studied by Vaamadeva and Paitheenasa seers and its origin in the zodiacal section of Hasta star is given. Similarly, Kethu has been studied by Mudhucchanda and Jaimini and his original point is in Revati star of the zodiac.

Cessation of the Vedic Growth

The growth of the Vedas which commenced far earlier to the Rg Vedic period appears to have come to a close sometime before Veda Vyasa, perhaps due to the onset and development of pre-Jain and Buddhistic concepts. However, Vyasa appears to have salvaged the best among the then available Vedic compositions and revived the Vedic school by putting an end to the inclusion to the Vedic literature anything later in order to preserve the samhitas in their pristine form.

The Vedangas or the Vedic adjuncts like the Shiksha, Vyakarana. Chandas, Nirukta, Jyotisha and Kalpa were already existing and they grew consequent upon the cessation of the Vedic growth. Also, decline of the 'age of sacrifice'—if it can be called, brought a complete renaissance in the 'Karma Kanda' aspect of the Vedas and gave way to the 'Gnana Kanda' aspect leading to the more fertile and comprehensive field of philosophical discussions of the Brahmanas, Upanishads, Darshanas, etc.

The data for all the later developments, however, came from the Vedas, for, the observations made in them extended over several generations and could not be done away with completely, although improvement could be effected over several systems of observations. Hence the Vedas were retained for their wealth of data, brevity, poetic grandeur, over and above all as a kind of spiritual undercurrent. As has already been mentioned, the vedic observations extended over a very long period when compared to the human history and underwent improvement during their growth by way of removing the unnecessary as 'Khila' and adding the reformed or the revised data. To that extent the Vedas retained their originality and are invaluable.

THE GEOLOGICAL ASPECTS OF JYOTISHA

Introduction

Jyotisha is one of the six adjuncts of the Vedas, others being Shiksha, Vyakarana, Chandas, Nirukta and Kalpa. Jyotisha, the "Science of Stars" developed by the Vedic people to time the yagnic events based on a calendar which was developed after lengthy observations spread over generations. Kalpa sootras were formulated incorporating rules to construct the Vedi or the sacrificial platform and also platforms and structures for astronomical observations. They needed mathematical basis and the origin of mathematics can be traced to these earliest periods. Mathematics in the Vedic texts is, however, difficult to unravel. The Vedic compositions were mostly for prayers. The mathematical foundations were laid for the Jyotisha and Kalpa adjuncts from great antiquity.

Lagadha's Vedanga Jyotisha has been often mentioned as the earliest text containing the astronomical knowledge of the Vedic seers to fix timing for their sacrificial activities. The time of its composition is uncertain though many agree about the authorship. The Vedanga Jyotisha is a small composition with 36 slokas. A yuga in the text is meant 5 years and a luni-solar system of measurement of time has been described in the text, with their adjustments as Kshaya masa and Adhika masa. The five years are named as Samvatsara, Parivatsara, Idavatsara, Anuvatsara and Idvatsara with differences in the days of individual lunar months. The lunar months have been recognised on the basis of the star in which the full moon appeared. This is noted to be far elementary and the availability of one text does not mean that it is the only one which was present in actual reality. Many systems might have been there and some school might have been following this system, specially under the name of Vedanga Jyotisha.

The astronomical treatises were called the 'Siddhantas'. As the name indicates they were treatises composed after a good deal of observation and confirmation of observations. Although many present day scholars opine that the period of Siddhantas is later than the Vedic, evidences are there to show that some of them are very very ancient. One such siddhanta which finds a place even to this day as an excellent astronomical-mathematical treatise is the 'Suryasiddhanta'. As the name indicates, the text must be as old as the Vedas and the study of the sun by the sages. Vedic rishis like Vishwamitra, Hiranystoopa, Kashyapa have been mentioned already as prominent seers of the sun. However, the authorship of Suryasiddhanta is given to be Mayasura, and the textual material is mentioned to be the result of the discussion between Mayasura and the sun, that is perhaps great revelations obtained after a good deal of observation of the solar movements applying the results of mathematical exercises. Perhaps 'Samvaada' may be a metaphorical way of expressing things in such a form.

Modern scholars should appreciate an important fact ebout these ancient texts. Of course the authors were from the stock of Vedic seers as such they usually presented their observations in the form of poetic compositions, including hard mathematics. To attain such a status in any language is not ordinary and will take a considerable time. For that matter, even to this day it is only in Sanskrit language that astronomical mathematical texts have been available in the form of verses which can easily be remembered. It is no exaggeration that a civilisation to nurture such a literary bounty could have been evolved in the human evolution only from distant past. Perhaps it may be difficult to accept that some sections of humanity attained such refined civilisation so early in the scale of human evolution, as much as several million years back, which cannot be accepted by modern standards of scientific data and evaluation. According to Primatologists, the latest period that the human evolution could have taken place is about 3.75 million years ago. They identify that form as 'Homosapien' to which all human beings belong. What is the scale of measurement of this evolution? For all the matter fossilised human skulls or parts of the body are very rare and only a few of such are available for study. The first evidence of primate fossil is from Burma and is dated about 60 million years of age based on geological factors. Change in forms is not very easy in terms of evolution of life and demands environmental changes which are only geological in ages. From the point of a few evidences on which these evolutionary theories are based, it is difficult to disbelieve in the antiquity of the Vedic and related texts.

Argument apart, the Suryasiddhanta is the oldest of its kind and appears to be worthy of its claim. It presents one of the most profound systems of measurements of time which is not known to any other civilisations. The "Kalpa Theory" expounded in the texts is something superb and is essentially based on astronomical data.

The mathematical background of the Surya Siddhanta has been able to present many of the astronomical and geological facts in a way which can vie with the most modern data. The circumference of the earth, the duration of the solar year, the lunar month, the disposition of the planets, their distances from the sun, the distance to starry groups and the expanse of the universe are some of the more interesting data in the text.

Amongst the most important is the observation on ayanamsha, i.e., the rate of precession of equinoxes. The rate of precession of equinoxes has been given great importance and based on their oscillation the Kalpa Theory was developed.

The Kalpa Theory

According to the Suryasiddhanta the precession of equinoxes is oscillatory and one oscillation is completed in 7200 solar years. The rate of precession on an average is 54'' per solar year. The equinoctial points are observed to oscillate about the nil ayanamsha position with a maximum distance of 27°, making a cycle of 108° in 7200 solar years. Such 600 cycles are mentioned to make one Mahayuga, accounting for $4{,}320 \times 10^6$ years. Such 1000 Mahayugas are mentioned to make up one Kalpa. Seven Kalpas have been mentioned and with each Kalpa measuring 4320×10^6 years, the time necessary to a cycle of Kalpas becomes considerable, and equitable to the order of present day considerations that the present creation is about 18,000 million years age, for, in the cycle of seven Kalpas only 4 have been completed and the 5th is now current.

In the present Kalpa 1955.885 million years are completed by 17/18 February 3102 B. C. Thus the total years completed will be :

$$
\begin{aligned}
4320 \times 10^6 \times 4 &= 17{,}280 \times 10^6 \\
&\quad + 1955.885 \times 10^6 \text{ solar years} \\
\hline
&\quad 19235.885 \quad \text{million years} \\
\hline
\end{aligned}
$$

have been completed by 18.2.3102 B. C.

Further, it is said that 4320 million years make a day of Brahma and an equal interval of time a night. Thus, a Brahma's life duration for 100 years will make the concept of creation something stupendous.

The seven Kalpas are given below :

1. Parthiva
2. Koorma
3. Pralaya
4. Anantha
5. **Swetavaraha** (running now)
6. Brahma and
7. Savitri

Each Kalpa consists of 14 Manvantaras. They are named as given below :

1. Swayambhuva
2. Swarochisha
3. Uttama
4. Tamasa
5. Raivata
6. Chakshusha
7. **Vaivaswata** (running now)
8. Sooryasaavarni
9. Indrasaavarni
10. Brahmasaavarni
11. Rudrasaavarni
12. Dakshasaavarni
13. Rouchya and
14. Bhaitya

And each Manvantara consists of 71 Mahayugas with 15 intervals of Kritayuga equal to 6 Mahayugas, thus making one Kalpa of 1000 Mahayugas. This is described in the Bhagavadgita as :

"SAHSRAYUGAPARYANTAM AHARYAD-
BRAḤAMANO VIDUHU
RATRIMYUGASAHASRAANTAAM TE
AHORAATRVIDO JANAH"

meaning that those who know that Brahma dina consists of 1000 Mahayugas and a Brahmaraatri also one thousand Mahayugas, they are called 'Ahoraatravidas' or Astronomers or Jyotishis.

Further, each Mahayuga consists of the bel given four yugas and their time interval as giv against :

Mahayuga	*Time duration*	*Ratio to Mahayuga*
Kaliyuga	432,000 years	1/10 th
Dwaparayuga	864,000 years	2/10 th
Tretaayuga	1,296,000 years	3/10 th
Kritayuga	1,728,000 years	4/10 th
	4,320,000 years	1 Mahayuga

Vedic performances start with reference to t calendar and is pronounced as follows :

"AADYA BRAHMANAHA DWITEEYA PARARDH
SWETHAVARAH
KALPE VAIVASWATAMANVANTARE KALIYUGE
PRATHAMAPADE etc., et

This calendar would have had no significance it not been for the radiometric age determinations known to modern science. The significance of system of time measurement may be appreciated the modern scholars.

The Role of the Earth in the Cosmic Cycl

In one Mahayuga, i.e., 4.32 million years durat the members of the solar family make the follo numbers of revolution around the sun :

The Earth	4,320,000
Moon	57,753,336
Mercury	17,937,060
Venus	7,022,376
Mars	2,296,832
Jupiter	364,220
Saturn	146,568

But for their strong mathematical foundations and uncanny observations over long periods extending at least a few millions of years, it would have been difficult to comprehend the knowledge of the ancient-seers to make the above observations.

The earth is but a sample representative of the Universe. Its origin, evolution and end is fittingly connected with the life of the sun, along with that of the other members of the solar family. This is verily a problem of planetary dynamics and the behaviour of the earth is much to do with its relationship with other planets. Its origin and evolution is genetically conditioned with the evolution of the solar system, hence, it cannot be treated as an isolated individual which has nothing to do with other celestial bodies. Not only that the earth has to do with the members of the solar family, it has also to be read in the context of the starry heavens, since the sun is influenced by the powerful members of stellar groups, specially moving round the centre of the Galaxy. In the context of the foregoing, it can easily be surmised that any theory of the earth formulated to explain its behaviour patterns like the onset of volcanoes, occurrence of earthquakes, movements of land masses, etc., should take into consideration all these factors and make it a Geo-Cosmic theory.

The Vedic philosophy includes such a theory of the earth but in a preliminary form. However, the observational data is considerable and many of them may also be utilised for the formulation of such a Geo-Cosmic theory.

Concept of Manvantara and Pralaya

According to Amarasimha's Naamalingaanushaasanam, Manvantara is described as consisting of 71 Mahayugas as in the sloka :

"MANVANTARAM TU DIVYAANAAM
YUGAANAAM EKASPTATIHI
SAMVARTAHPRALAYAHKALPAHA
KSHYAHKALPAANTA ITHYAPI"

Which also says that 'Pralaya' is the dissolution at the junctures of Manvantaras in a Kalpa and the end of a Kalpa is called 'Kshaya'. Pralaya may be due to water when called 'Jala Pralaya' or due to fire when called 'Agni Pralaya'.

One Manvantara is of 4.32 × 71 million years duration. Hence, at about every 300 million years or so (306.72 million years to be precise), there will be a Pralaya. It is quite evident that geological activities of great significance have coincided with such 'Pralayas' both of Jala and Agni.

The sun is the time reckoner. Manu also suggests as a measure. The sun's movement around the galactic centre appears to have been taken into consideration in naming the various cycles as 'Manvantaras'. This would suggest that there are significant sensitive points on the solar orbit around the centre of the galaxy which is of great geological interest.

The Vedic data, although of considerable antiquity, does not contain in their present available form any observations as to such distinct geological changes of mountain formation. The geological data that is available to us at present permit such a correlation and the evolution of the earth punctuated by such Pralayas can be attempted for a closer understanding in formulating a Geo-Cosmic theory.

Other Siddhantas of Antiquity

Apart from the Suryasiddhanta, Pitamaha Siddhanta, Romaka or Lomasha Siddhanta, Puolisha Siddhanta and Vasishta Siddhanta are regarded as of great antiquity. These were reviewed by Varahamihira later in his Pancha Siddhantika. But none of these are comparable in grandeur and astronomical-mathematical aspects to the Suryasiddhanta. Of course, nothing is available now of the Pitamaha Siddhanta except what has been mentioned by Varahamihira. Some of the Siddhantas are noted to contain materials foreign like the Romaka and Poulisha. The Vasishta Siddhanta appears to be on par with the Suryasiddhanta in certain aspects only.

[illegible]
जयपुर परिसर, जयपुर
51पुस्तकालय
क्रमांक........
12164

The Geographical Aspects of the Suryasiddhanta

The geographical aspects mentioned in the Suryasiddhanta make one perplexed about the distribution of some continents as compared to their present day disposition. Lanka, Romaka desha, Siddhapuri and Yamakoti are described to have been at equidistant on the equator. Considering these names as equivalent of modern Ceylon (now Lanka), Romaka (Rome), Siddhapuri (Mayan or the Nazka or Inqua region of the Americas) and the Yamakoti (or Yuvakoti as Java islands), their disposition makes one ponder over the geological changes that might have been responsible for their movement from the original disposition stated according to the Suryasiddhanta. This has been discussed by the author elsewhere, and here it is suffice to say that they correspond to the modern concepts of earth sciences, specially involving the theory of "Plate Tectonics".

Instrumentation

The instruments that the ancients might have used for their astronomical studies appear to be debatable. The Kalpa Sootras do describe the construction and their procedures of perhaps the earliest mini observational platforms, etc. It is difficult to arrive at any clear understanding about the instrumentation which they had to use in refining astronomical data. To find out the average rate of precession of equinoxes as has been given in the Suryasiddhanta the instruments they might have used sppears to be most refined ones or methods and procedures something extraordinary. A look at the observatory constructed by Raja Jai Singh itself is sufficient evidence to arrive at the fact that similar observatories would have been present using which they could arrive at such accurate results.

THE GEOLOGICAL ASPECTS OF THE VEDANTIC AND RELATED TEXTS

Introduction

While the Karma kanda section of the Vedas was given importance by certain groups of people, certain other groups entered into philosophical pursuits. Vedic texts were discussed threadbare and several new fields of knowledge were explored. Some of the Rishis examined the problems of sacrifice in depth and came to the conclusion that the 'Karma Theory' of the Vedas would lead men only to get more involved in the birth and death cycle and do not yield a better way of existence. However, it was also difficult to get rid of the grand Vedic way of life. They took to deep meditation on subjects of universal importance. They tried to answer the Vedic questions of "Who created this Universe? How was it actually created?" and also to find a way out of the cycle of birth and death.

Thus, the Upanishads, Brahmanas, Aranyakas, etc., came to grow out of the Vedic compositions. Some of them propounded many important philosophical ideas. Rishis like Kapila, Patanjali, Kanada, Goutama Jaimini dealt the subject at length and shastras or 'Darshanas' as they have come to be called were developed. They examined the problem in great detail through the school of Sankhya, Yoga, Vaisheshika, Nyaya and Meemamsa to understand the way the fundamental principle of the Universe is working. Since most of the literatures were based on a spiritual background as has been described in the Vedic hymns, the philosophy was also based on a grand spiritual foundation. Finally they arrived at the conclusion that the individual spirit (atma) is the same as the Universal spirit (Brahman), culminating in the "Monistic" school of learning.

The Upanishads

There are numerous Upanishads which have grown out of the Vedic soil. Of all of them, some ten, have been given pride of place and are called 'Dashopanishadaha'. These Upanishads, the Bhagavad Gita and the Brahma Sootras, make up the final 'Trijunction' of the Indian Philosophy. They are referred to as the 'Prasthanatraya', a clear exposition of which is given to make one know the 'Real' or the 'Truth'.

Although mostly the spiritual aspects of the Universe have been discussed in all these texts, some of them have given importance to describe the truth underlying the material Universe also. This section is important to us, specially as relating to the modern school of scientific philosophy more meaningful.

While the Upanishads contain the same hymns as in the Vedas but fewer pregnant with meaning, some schools have also advanced additional statements to make them clear and more rational. The Bhagavad Gita and the Brahma Sootras are, however, attributed to the authority of Vyasa.

Taittariya Upanishad

Of all the Upanishads, Taittariya Upanishad gives us the materialist background of the Universe, specially in a magnificent way. It describes the five natural groups of elements as 'Pancha Bhootas'. It is observed that one group is more fundamental than the succeeding and a kind of evolution in them has been traced. Finally, the space is described as most fundamental of all the groups of elements.

According to Taittariya Upanishad these are the five groups of elements in order of evolution.

1.	Akasha	space
2.	Vayu	air
3.	Agni	fire
4.	Apah	water
5.	Prithivi	earth

Further, their qualities have also been described as follows :

Akasha is qualified by sound = Shabda
Vayu is qualified by touch = Sparsha
Agni is qualified by form = Roopa
Apaha is qualified by taste = Rasa
Prithivi is qualified by smell = Gandha

By order of evolution from above 1 to 5, the succeeding group of elements gain the qualities of all the previous ones. Thus vayu qualified both sound and touch, fire-sound, touch and form, water-sound, touch form and taste, earth-sound, touch, form, taste and smell.

The individual groups of elements are called Tatwas or fundamental note. These tatwas have been found related to time in a particular order or sequence. This is given below :

Tatwas	*Duration of time*
Space	30 minutes
Air	24 minutes
Fire	18 minutes
Water	12 minutes
Earth	6 minutes
Total :	90 minutes

Thus, a duration of 180 minutes (a wave of 90 minutes rise and 90 minutes fall) is called 'Yaama' and there are 8 yaamas in full day, i.e., from sunrise to the following sunrise, when the total duration is exactly 24 hours. According to Tatwa Siddhanta, these fundamental notes trace the evolution of the Universe "manifest" from the Universe "unmanifest". The Universe is described in a later composition attributed to Devala in his Mahasamkalpa or Great Creation, as having been enveloped by these five groups of elements according to the statement :

"ATHAANANTA VEERYASYAASYA
SRIMADAADINAARAAYANASYA
APARIMITA SHAKTYAABHRIYAMAANASYA
MAHAJALOUGHA MADHYE
PARIBHRAMAMAANAANAAM ANEKA KOTI
BRAHAMANDAANAAM EKATAME
VYAKTAAVYAKTA PRAKRITI
MAHADAHANAKAARA PRITHVYAPTAJO
VAAYURAAKAASHAADYAAVARNAIRAAVRITE"
etc., etc.

Thus it appears, that the question of the Vedic rishis as to the phenomenon of creation of the Universe, has received answer in the Upanishads. All these and many more observations have led to a closer understanding of the earth and other celestial bodies in improved version in the ages that followed the most ancient Vedic schools. Later they have been able to analyse the time factor in the Universal evolution and their understanding of time scale of the Universe already presented makes the "Theory of the Earth" in a way almost complete, Since all the celestial bodies in the manifest Universe are the result of evolution from space, they qualify in varied proportions the nature of the fundamental elemental groups. They were able to recognise the specific nature of celestial bodies closer to the earth easily and of distant bodies like stars in a difficult way. Further, interaction between these bodies on the earth individually and in combination of groups could be deciphered during their movement on the heavenly path. The later theories based on such observations owe much to the earliest Vedic concepts and a complete description of such a theory given in the later texts will be dealt with elsewhere.

Conclusion

A study of the Vedic compositions clearly reveals the foundations of a "Theory of the Earth" which was later developed by astronomers in India to great advantage. That such a theory originated in the Vedas is made clear in the above presentation and it stands to reason that although the Vedic people were not conversant with the modern principles of geology they appreciated the importance of such a theory and tried to propound the same.

GLOSSARY

Important General References

Rg Veda Mantrasamhita Ed. Janardana Mahadeva Gurjara, Bombay, 1918.

Vedic-Hymns, 2 Vols. Sacred Books of The East Series, Vol. No. 32-46 by F. Max Muller & H. Oldenberg.

"Saswara Vedamantrah", Sri Ramakrishnashrama, Bangalore. 1974.

Rg Veda (in Kannada), Krishnaswamy, University of Mysore, 1955.

Summer School of History of Science, Indian National Science Academy, New Delhi, 1974.

Atharvaveda, C. G. Purushottama, Mysore University, 1958.

Suryasiddhanta, Sri Tatwamrita commentary, Kapileshwara Chowdhary, Kashi Sanskrit Series No. 144, 1946.

Bharatiya Samskrit Darshana (in Kannada), Ed. A. N. Krishna Rao, Government of Mysore, 1962.

The Golden Womb of the Sun, P. Lal, Calcutta, 1970.

The Antiquity of Hindu Astronomy and the Tamils, V. Tiruvenkatacharya, Madras, 1970.

The Origin of the Earth and the Planets, Boris Levin. Moscow, 1958.

Earth's History & Plate Tectonics by C. K. Seyfert and L. A. Sirkin, Harper & Row, 1973.

Principles of Geodynamics, A. E. Scheidegger, 1963.

The Dawn of Astronomy, N. Lockyer, MIT, USA, 1964.

The Founders of Geology, A. Geikie, 1962.

A Source Book in Geology, K.F. Mather and S. L. Mason, McGraw Hill, New York, 1939.

Internal Constitution of the Earth, Gutenberg. B. Dover, 1949.

The Earth, Jeffrys, H. Cambridge, 1929.

Frontiers of Astronomy, F. Hoyle, Mentor Book, 1955.

The Origin of Continents and Oceans, A. Wegener, English translation by John Biram and B. C. King Matheun. 1970.

The Thirteen Principal Upanishads. Translated from Sanskrit by Robert Ernest Hume, Oxford, 1968.

Srimadbhagavadgita, Shankara Bhashya, Gita Press, Gorakhpur, 1931.

Brahma-Sutras, Swami Vireshwarananda, Advaita Ashrama, Mayavati, Almora, Himalayas, 1931.

Taittariyopanishat, V. Ramaswami Shastry & Sons, Madras, 1939.

Earth Science Studies in Sanskrit, S.R.N. Murthy, The Mysore Orientalist, Vols. VI–VIII, 1972–5, pp. 63–75 Oriental Research Institute, Mysore.

Earth Science Studies in Ancient India—An outline : S. R. N. Murthy in 125 year Anniversary Volume, 30, Indian Minerals Spl. publication of the Geological Survey of India, Calcutta 1976.

Geological Evidences in support of the antiquity of some ancient Indian events, S. R. N. Murthy, submitted to Indian Journal of History of Science, Calcutta–1, Indian National Science Academy.

A Critical evaluation of mineralogical aspects of some Sanskrit Texts, S. R. N. Murthy, submitted to the Indian Journal of History of Science, Indian National Academy of Science, Calcutta-1.

VARAHAMIHIRA'S CONTRIBUTION TO THE VEDIC THEORY OF THE EARTH

Abstract

The author presents various observations made and compiled by Varahamihira on the changes of the animate and inanimate fields of the earth in his text Brihatsamhita, specially correlated with the movements of various members of the solar system through the ecliptic. Some important points of compilation of earlier observations have been explained by modern geological understanding. The changes in the atmosphere, formation and precipitation of clouds, the crop position, the rainfall, changes in sociological, political and other fields, etc., correlated with the movements of the heavenly bodies are presented, The data presented include observations of several generations of humanity, specially from Vedic times to the times of Varahamihira.

It is presented as the preliminary concepts of a Theory of the Earth, which needs verification at the present juncture of history. The predictive element in the theory is appreciated, specially to trace the annual

outcome of the terrestrial changes by considering certain specific correlations.

Introduction

The cosmic theory of the earth recognised in the Vedas received considerable attention during the post-Vedic times. Many sages contributed to the growth of stellar science but of many students of the subject some 18 were considered by Kashyapa. They were:

Surya, Pitamaha, Vyasa, Vashista, Atri, Parashara, Kashyapa, Narada, Garga, Marici, Angiras, Lomasha, Poulisha, Cyavana, Bhrigu, Shounaka, Pulasthya, Vishwasrid, Vishwamitra, Kanwa and many others also made significant contributions. However, not all the texts of astronomical treatises were available for the later authorities and by the time of Varahamihira, although much development was witnessed in astronomy, many of the texts were lost. Of the available literature now, that of Varahamihira is the most authentic and he has presented in his text 'Brihat Samhita', a summary of all important observations which were available to him.

The subject of stellar science was studied under three major divisions, viz., principles of astronomy, construction of ephemeries and presentation or interpretation of results based on earlier observation, i.e., the predictive section. All the three divisions of stellar science received considerable attention by many students and the observations made by them appear to have been stupendous by the time of Varahamihira. He has been able to present a compilation as he states, specially with his own critical evaluation. Not only the correct movements of the celestial bodies were ascertained, but also their effects on terrestrial phenomena correlated to their specific dispositions. Similarly, events were predicted based on advanced calculations of comparable planetary dispositions.

What is the basis of such a theory which calls or establishes the relationship between the earth and the heavenly bodies? How the terrestrial phenomena get influenced by the heavenly bodies which are at such distance? The heavenly bodies were called by the students of Jyotisha as 'Grahas' meaning those which 'attract' or 'drag', since they were in movements in circles and dragged by others. This was recognised by the Vedic seers who described the law of movement of all these bodies as 'Rta' which also caused the seasons, hence they were addressed as 'Ritus'. Based upon the advanced calculations of the movements of 'Grahas' they could predict the events on similar earlier observations, they came to the conclusion that the universal theory they had adopted was correct and expressed truth of existence, specially of their concept of 'ATMA' and 'BRAHMA' relation, i.e., Pindanda and Brahmanda correlation. More than this they could not establish any visible evidence of such a fundamental relationship. Since the Vedas contained most of the results of the Stellar Science, the foundations of which were questionable but the results of which were practically verified and proved to be true, they agreed to keep the

Vedas above anybody's questionable premises. That is why Sayanacharya defined the Vedas as :

> "PRATYAKSHENAANUMITYAA VA
> YASTOOPAAYO NA BUDHYATE
> ENAM VIDANTI VEDENA TASMAD VEDASYS
> VEDATA"

meaning that the sanctity of Veda is in its effect making clear the result which is not ordinarily known by evidences seen or inferred. Hence, the grand truths of the Vedas came to be recognised as above 'TIME' & 'SPACE' and they are eternal truths. In this sense, nobody can establish a direct contact between the earth and other heavenly bodies to explain these facts which have been correlated. The forces which are actually responsible for the movement of the earth and other celestial bodies is invisible and the 'drag' or attraction or more refined laws of Relativity. Even then they just do not accept the presence of any influence of these extra-terrestrial bodies on the earth, since there is no direct visible contact between and amongst themselves. It is just like the relationship that prevails between passengers of a moving bus, who little realise that all of them are moving with the speed of the bus. There cannot be any direct relationship than the spin of the earth itself without which there can hardly be any day and night. Since the Vedic seers could realise this early, they could establish the Theory of the Earth and record the influences of various celestial bodies in motion on the animate and inanimate objects of the earth. In the work Brihatsamhita, Varahamihira has presented the geological influences of the various members of the Solar family during their movement through the heavenly path.

Correlation of the Terrestrial Events with Solar Phenomena

At the outset, Varahamihira observed that during some past age the sun's apparent southerly movement used to commence from the latter half of Aslesha star and the apparent northerly movement from the beginning of Dhanishta star, since such a discussion has been presented in literature earlier to him. This is a very important point. Further, observations by him suggested that if the sun did not continue his southerly movement after reaching Karkataka rasi and his northerly movement after reaching Makara rasi, the result would be destruction.

In the case when the sun does not enter Makara and returns to south then destruction to places situated in the south and west ; and in the case when he does not enter Kataka and returns to north then destruction to places situated in the north and east are mentioned. This observation has been made by Varahamihira based on the earlier observation by Garga. Garga observed that when the sun returns not reaching Dhanishta star in Uttarayana and does so not reaching Aslesha in Dakshinayana, then it suggests great fear due to geological changes. This observation was due yet earlier to Parasharà, hence more than one authority has subscribed to this fact.

This observation may look absurd to a non-geoscientist. The modern students of the earth will consider this observation with great admiration and care, for fear due to geological changes during such rare phenomena is obvious, since such a change involves either a slow or sudden but of short durational changes in the earth's pole. Change in the disposition of the earth's pole has been recognised in the geological past, specially during the last 60 million year history of the earth based on palaeomagnetic studies. The change in pole disposition of the earth causes changes in the distribution of ice caps, climate and land and sea distribution caused by changes in the geophysical phenomena. Unless such activities had been witnessed a discussion like this would not have been possible in the early texts. Thus the antiquity of record is itself a proof to confirm the modern concept of polar-wandering as it is called. The concept will receive more attention in the treatment later.

Another observation is that the sun, excepting parva days, if seen covered with darkness (sunspot), the situation portends many terrestrial changes. This observation is also confirmable from modern studies when geological changes have been correlated with the occurrence of sunspots or dark spots on the sun. This dark cover of the sun is referred to as 'Twashta' and is said to cause danger from fire and famine.

Depending upon the nature of darkness within the disc of the sun or moon during eclipse, some very relevant observations have been made. Before such dark covers form on the disc of the sun or moon during eclipses, there will be disturbance of groundwater and surface water, occurrence of tornadoes, high speed winds charged with dust particles destroying the mountain peaks and forests, appearance of fruits and flowers exceptional to the seasons, excessive heat of the sun, burning in certain directions, charging of powerful winds on the earth, etc. These phenomena indicate the appearance of dark cover on the disc of the sun and moon within a week. If such dark covering is not seen during this period, there will be untoward biological effects in the directions of the occurrence of these phenomena.

If the dark cover on the disc of the sun appears which resembles a stick political disturbance, which resembles a headless body fear of epidemic, resembling the crow increase in thefts, and resembling 'Keel' then famine are indicated. If these phenomena are followed by immediate rains, there will be peace.

If the sun looks to be of the colour given below during the seasons mentioned against, then it will portend prosperity :

Seasons	*Colours*
Shishirrt	red or white
Vasantrt	green or reddish
Greeshmrt	golden or whitish
Varshrt	white or pale white
Sharadrt	centre of lotus
Hemantrt	blood red

Blood red coloured sun in Greeshmrt indicates some kind of fear in biological field, dark sun in Varshrt indicates rainlessness, pale white or yellowish sun during Hemantart indicates fear of epidemics.

During Varshrt if the sun has the hue of shereesh flower there will be rains immediately; but if the sun is of the hue of peacock feather, then there will be no rains for 12 years.

If the sun looks with cloudy shade, then there will be destruction due to insects, if he is seen with the shade of smoke then there will be political disturbances.

If the sun disc is looked with the colour of the blood of hare, then there will be war. Of the colour of the moon the sun disc indicates political changes.

If the sun disc appears resembling a pot, then those countries witnessing the phenomena will suffer from famine. Also if the sun disc appears to purturb like the flag or the wire of bow, then there will be war. Dark lines in the sun disc portend death of the political head by ministers.

Fall of meteor, strike of thunder etc., at the sunrise portends change of political head. Similar results are noted when the sun is surrounded by a rim of dust (Parivesha) during sunrise and sunset, when political change is certain.

After sunrise for about an hour a small circle illuminated by the sunrise looks like another sun and is called 'Pratisurya'. If Pratisurya is to the north of the sun, rain to the south and storm, on both sides political change and to the lower side biological destructions are indicated.

The sun of pure rays, of complete disc, of bold outline, of unpurturbed nature, without any kind of dark spot, etc., portends prosperity and peace. It is also noted that the star on the background of the sun durlng the alignment of the earth is believed to get purified by the rays of the sun.

Correlation of the Terrestrial Events with the movements of the Moon

After describing the mechanism of increase and decrease of lighting of the moon from the sunlight, Varahamihira proceeds to observe that when the moon transits south of Jyeshta, Moola, Poorvashada and Uttarashada, there will be destruction of seeds, life in oceans and forests. Some ten kinds of lunar disposition have been recognised and are correlated with terrestrial events. The earlier authorities appear to have paid more attention to these lunar dispositions, specially of the new moon. Nou, Langal, Dushta-langal, Samashring, Karmuk, Parshwashayee, Avarjit, Kundakar, Uttar-shring and Dakshina-shring are the ten new moon dispositions.

The disposition called Nou, when the new moon resembles the outline of a ship, causes difficulties to naval people. When the new moon has its one horn half raised it is called Langal, indicates difficulties to people engaged in ploughing, and unusual friendship amongst the rulers. That disposition of the moon is called Dushta-langal when the southern horn of the moon is half raised and indicates army movement and destruction to the Pandyan king. When both the horns of a new moon rise equal then such a disposition of the new moon is called Sama-shring and portends peace and prosperity. It the new moon resembles a stick then there will be death to cattle and severe punishment order by law. When the new moon rises with a disposition resembling that of a bow, then there will be war and the party lying to the side of the string will win. When the horns of the new moon get widened in the north and south then it is called Yugasthan and indicates earthquakes. When in the Yuga disposition there will be a little increase in the height of the southern horn, the structure goes under the name Parshwashayee and portends destruction to business magnates and rains. When one of the horns of the moon is directed downwards then the disposition is called Averjit and portends famine. When the new moon looks round the disposition goes under the name Kundakar and indicates defection of subordinates. While the disposition called Uttarashring, with the horn of the new moon raised to the north, suggests peace and plenty, the disposition with the horn raised to the south called Dakshinashring portends fear and famine. When one of the horns of the new moon is totally unseen or downward or of a new form, then instant death of the person witnessing the scene is mentioned. If the disc of the moon is small then famine, if it is large peace and plenty are indicated.

The lunar horn struck by mars indicates death to administrative heads placed at great distance, struck by saturn indicates fear of hunger and of weapons (war), struck by mercury no rains and famine, struck by jupitar death to famous rulers, struck by venus death of some local rulers are indicated. During the bright fortnight the results mentioned will be partial and complete during dark fortnight. If the lunar disc is affected by venus then fearful death will take place for seven months in Magadh, Yavana, Pulinda, Nepal, Bhringi, Kutch, Merudesh, Surat, Madras, Punjab, Kashmir, Kulootak, Purushad and Usheenar regions. If the lunar disc is affected by jupiter then there will be destruction of grains for ten months in Gandhar, Sovira, Sindhu, Keera, Parvatiya and Dravid regions. The lunar disc affected by mars indicates destruction to peoples in Trigart, Malava, Koulind, Shibi and Ayodhya regions. Also death of administrative heads in Kuru, Mathsya, Shukti regions is mentioned to be caused within six months by this affliction. Saturn afflicting the lunar disc causes death and destruction to the people and administrators of Kuru land and dynasty and the rulers of the east lands, for ten months. Mercury affecting the lunar disc suggests destruction of the people of Magadh, Mathura and those residing on the bank of Vena river but causes prosperity and plenty to those people of the western lands.

Fall of meteor at the time of eclipse indicates death of the rulers governed by the star in which eclipse takes place. If moon is ash coloured, red or dark, or purturbed, it portends famine, epidemics, etc.

CORRELATION OF TERRESTRIAL EVENTS WITH THE ECLIPSES, ETC.

Introduction

Observation of eclipses and their knowledge of occurrence in advance has been as old as the Vedic compositions. In the Vedas, as has already been mentioned, Swarbhanu was thought to cause eclipses. This is clear from the Vedic observation that :

"SWARBHAANURHA VA AASURI TAMASAA VIVYAADHETI" etc.

But Varahamihira describes the occurrences of eclipses on lines as scientific as modern as due to the shadow of the sun on the moon due to earth as eclipse of the moon and the shadow of the sun on the earth due to moon as eclipse of the sun. Eclipse is called 'Grahana' as also 'Uparaaga' according to Naamalingaanushaasanam which mentions that :

"UPARAAGO GRAHE RAAHU GRASTE TU INDOU CA POUSHNI CA"

and suggests that the term 'Uparaaga' is used to denote some kind of additional colour or change in the original hue of the sun or the moon due to eclipse. 'Grahana, means literally 'absence of graha or the heavenly body' since on account of complete eclipse the heavenly body either the sun or the moon will not be seen for the duration of eclipse.

The early authorities in astronomical disciplines have been able to correlate many important events to eclipses. In relating such events to the eclipses, it has perhaps become customary to say that they have been "due to" the eclipses since such events have been more than one time confirmed. Even though, it may be erroneous to say that the eclipses have caused such and such an event, it is certainly correct to say that those events are correlated to the heavenly phenomena.

Varahamihira observed that some earlier authorities said that if there be a grouping of five heavenly bodies on any new moon or full moon day, then no eclipse will take place. If an eclipse occurs, then on the preceding 8th day of the bright or the dark half, the direction of commencement, and end of the ensuing eclipse may be ascertained by pouring oil on water and observing the direction of spread of oil on water. But Varahamihira says that there will not be eclipse if there be a combination of five heavenly bodies on a full or new moon day. Further, he observed that eclipses should be ascertained by the astronomical procedures laid down for eclipses.

From the commencement of Kalpa, successive periods of each six months are named as Brahma, Shashi, Indra, Kubera, Varuna, Agni and Yama. Eclipse during Brahma period is correlated with all round prosperity; Shashi perid also with all round prosperity but shortage of rains ; Indra period with differences amongst administrative heads, destruction of crops of Sharadrt and sickness to people ; Kubera period with destruction of money of wealthy but prosperity to people ; Varuna period with untoward for administrators, good for public and increase in corns ; Agni or Mitra period with increase in corns, good health of public and sufficient rains ; Yama period with shortage of rains, destruction of grains and famine.

If eclipse occurs earlier than the period indicated by calculation such eclipse is called 'Velaaheen' ; if beyond then 'Ativela'. Velaaheen eclipse is correlated with destruction of rainy clouds, and indication of wars. Ativela eclipse is correlated with destruction of orchards of fruit trees and grains.

The following observations are according to earlier authorities says Varahamihira and observed that there cannot be any. eclipse which is not ascertained by astronomical calculations. It appears that the above observations were some kind of a thumb rule of six months duration enunciated by early workers and Varahamihira just dismisses their outlook of Velaaheen and Ativela, etc., types of eclipses, specially based on his mathematical conviction.

Varahamihira next oberved (in contrast to the belief of the six-month period) that if two eclipses one of moon and the other of the sun occur within one lunar month then there will be disturbance in the army and the danger to the administrative head. Also, rising and setting of partially eclipsed moon is correlated with destruction of grains of Sharadrat and rising and setting of partially eclipsed sun with destruction of the administrative head. The completely eclipsed sun or moon associated with other heavenly bodies like the saturn or mars are correlated with famine and mass destruction of people.

Half risen sun or moon under eclipse are correlated with reference to the commencement and end of eclipse. The duration of day and night into seven sections is suggested and the following biological changes are noted based on the commencement of eclipse. Commencement of eclipse of the half risen sun or moon in the first division is correlated with the affliction to the section of people who live by thermal means; second division with farmers, business people, fighters and chiefs of forces; third division with artists and ministers; the fourth division with affliction to administrative head of the central regions and effecting fair-price of grains; the fifth division with the affliction to ministers, business community, cattle; the sixth division with affliction to relievers and saints. The division in which eclipse ends, the facts observed of that division will be favourable.

Eclipse during the sun's apparent movement in the north is correlated with affliction to scientists and soldiers; the eclipse during sun's apparent southerly movement is correlated with affliction to business and labour communities. Eclipse in the north is correlated with danger to scientists ; in the east to politicians ; in the south to business people ; and in the west to labourers. Other mundane effects and biological changes noted when the eclipse occurs in the north are affliction to cattle ; in the south, affliction to elephants and life in water ; in the east, the earth will be flooded ; in the west, affliction to farmers and labourers and destruction to seeds.

Local changes correlated with eclipses

Many local changes, specially pertaining to the sub-continent of India are enumerated by Varahamihira based on correlation of eclipse occurring in specific divisions of the ecliptic or the zodiac. Accordingly when a solar or lunar eclipse occurs in the first division (of the 12 ecliptic divisions of 30° each are from the 0° celestial longitude) there will be affliction to the people of Punjab, Kaling, Oudrha, Kirat areas and people living on thermal means ; in the second division, affliction to cattle, dairy farm managers and honourable citizens ; in the third division affliction to respectable women, administrators, artists, people living on the banks of Yamuna river, of Bahlika desh, Madhya desh (Saketa, Mithila, Campa, Kusha, Koushaambi, Ahikshetra, Gaya, Vindhya) and Sahya desh ; in the fourth division affliction to people of Abheera, Shabara, Pallava, Mathsya, Kuru, Shaka and Punjab areas as also wrestlers and invalids; in the fifth division, affliction to people of Pulinda, Kings and those living in forests and people with power ; in the sixth division, affliction to grains, and lands of plenty or crops, people of Tripura and those who live by arts including painting, poetics, drama, music, and rocks; in the seventh division, affliction to people of Avanti, Dashaarn, Maru and Kutch areas and business community; in the eighth division, affliction to people of Udumbar, Madra and Chola desh, fighters and dealers in weapons; in the ninth division, affliction to ministers, important persons, people living in Mithila, Punjab, wrestlers, medicos, fire-armourers; in the tenth division, affliction to life in the seas, ministers, people with base jobs, magicians, medicos, and armourers; in the eleventh division, affliction to people living in mountains, people who carry loads, relievers, those who live in western countries and people of Darad, Simhanagar and Burbara desh; and in the twelfth division, affliction life in the oceans and oceanic produces and wise people.

The Ten Types of Ecliptic Shadows and their Correlation

Savya, apasavya, leha, grasana, nirodha, avamardana, aroha, agrata, amdhyama and tamontya are the ten patterns of ecliptic shadows and are correlated with various terrestrial phenomena.

When the ecliptic shadow moves on the south of the body it is called 'Savya' and is correlated with sufficient rains, peace and prosperity on the earth. Movement of the ecliptic shadow on the left side of the body is called 'Apasavya' and is correlated with great affliction to political heads and the people.

Ecliptic shadow resembling a tongue goes under the name 'Leha' and suggests a world happy with plenty and prosperity. When the ecliptic shadow is half, a third or a fourth size then it is called 'Grasana' and is correlated with the destruction of wealth of a very rich king. If the ecliptic shadow gets round in the centre from four sides of the disc then it is called 'Nirodh' and is indicative of biological harmony on the earth. If the eclipse is of long duration and the shadow completely covers the disc then it is called 'Avamard' and is correlated with the destruction of the principal ruler and the chief of state. The instant relapsing of eclipse, though not recognised, is called 'Arohan' based on earlier observations and is correlated with severe fighting amongst rulers. If the disc is seen covered by smoke and water vapour and resembles like an unclean mirror, then it is called 'Aghrat' and is correlated with good rains and increase in life. The pattern is called 'Madhyatam' when the shadow of the eclipse occupies the centre leaving the four sides clear and is correlated with affliction to Madhya desha and sickness in stomach. Ecliptic shadow bordering the disc and leaving the centre bright is called 'Tamontya' and is correlated with destruction of grains and life. The affliction in Tamontya is called 'Itibadha' and is said to be six types due to excessive rains, shortage of rains, destruction by rodents, shalabhas and parrots as also excessive taxation by the rulers.

Mercury's aspect on the eclipsed sun or moon is correlated to the destruction of ghee, honey and oil ;

that of mars with war, fire accident, etc.; that of venus with grains, etc.; and that of saturn with famine and shortage of rains. Aspects of jupiter on the eclipsed sun or moon will relieve all the evils portended by the aspect of other planets.

If mars is associated with the eclipsed sun or moon, then people of Avanti, haughty kings and those living on the banks of Narmada and Kauveri rivers will be affected; if mercury is associated then people of Antarvedi (land between Ganga and Yumana), Nepal, and those living on the banks of Sarayu, Shona and east sea as well as administrators, women, children and aged will be afflicted; if jupiter is associated then people of Sindhu meet death and those living on the banks of Sindhu river and also those living in the northern parts as well as learned, ministers, rulers, horses and elephants will be afflicted; if venus is associated then people of Dasherak, Kaikeya, Youdheya and Shibi regions as well as women, ministers, etc., will be afflicted; if saturn is associated then people of Pariyatr and Arbud mountain regions, people of Sourashtra, Pushkar and Marushtal and labour force will be afflicted.

Correlation of Eclipses according to Lunar Months

Varahamihira then gives a list of correlation of the biological and sociological changes attended by eclipses during the full or new moon of various lunar months.

Lunar Months	*Terrestrial Changes* (Biological, Sociological and other affliction to)
Kartika	People of Magadh, Koshal, Kalmash, Shoorasen, Kashi and also who live on job associated with fire ; also minister and king of Kaling will be endangered.
Margashira	There will be sufficient rains and grains on the earth but people of Kashmir, Koshal and Poundar regions and wild life will be afflicted.
Pushya	Differences between scientists and politicians ; people of Sandhav, Kukur and Videh will be afflicted and there will be shortage of rains causing famine conditions.
Magha	People of Anga, Vanga, Kashi and good citizens, horses and elephants will be afflicted. Considerable rains will prevail.
Phalguna	People of Bengal, Ashmaka, Avanti and Mekhaldesh as also artists, sculptures, grains, etc., will be afflicted.

Lunar Months	*Terrestrial Changes*
Chaitra	Artists, musicians, jewellers, learned in the sacred texts, and those inhabiting Poundar, Oudr, Kekaya and Ashmak desh will be afflicted.
Vaishakha	Destruction to cotton, sesamum, greengram crops and people of Ikshwaku, Shak and Kaling regions will suffer from epidemics.
Jyeshta	People of Salva desh and those in the northern parts as well as political heads, grains and rains will be afflicted.
Ashadha	People of Gandhara, Kashmira, Pulinda and China desh and those who live on fruits and water and those whose jobs are with water resources will be afflicted.
Shravana	People of Kashmir, Pulind, China, Yavana, Kurukshetra, Gandhara, Madhyadesh and Kambhoja and grains which grow during Shardrt will be destroyed.
Bhadrapada	People of Kalinga, Vanga, Magadh, Sourashtra, Mleccha, Souvira, Darad, Ashmak regions and foetus of pregnant ladies will be destroyed.

Lunar Months	*Terrestrial Changes*
Ashvayuja	People of Kambhoja, China, Yavana, Bahlika, Sindhu, Anart, Poundr regions and the surgeons will be afflicted.

These observations can be verified even to this day and the list may need some modifications specially in the context of the modern civilisation. Many of these observations are incorporated in the Hindu Almanacs at present (Panchang) and many stand the test of time.

Based on the direction of the shadow leaving the disc of the moon at the end of eclipses, some more observations have been made. They are listed below as given in the text.

Direction of ecliptic		**Mundane Terrestrial Changes**
Moksha	*Name*	*Mundane*
Southeast	Dakshinahanu	Destruction of grains, facial sickness, good rains, affliction to the political head.
Northeast	Vamahanu	fear of war, facial sickness and peace and plenty.
Southside	Dakshinakukshi	fight amongst the political heads in the south.

Moksha	*Name*	*Mundane*
Northside	Vamakukshi	destruction of pregnancy in women and even grain crops.
Southwest	Dakshinapayu	diseases of genitals and little rains.
Northwest	Vamapayu	death to political heads.
East to East	Sacchardan	Plenty and prosperity on the earth.
West to West	Jaran	War tendencies and disturbed peace on the earth.

In the case of eclipse of the sun, the directions mentioned above should be read opposite and the results correlated.

Within a week after the eclipse if there be fall of meteors then there will be destruction of crops ; fall of snow and the fear of epidemics ; earthquake, death of the political head ; large fall of meteorite, death of ministers, of variegated clouds ; lightning, affliction to political heads, reptiles, wild animals ; parivesh, epidemics ; digdah, fear from political heads ; storm, fear of some loss ; nirghat, indradhanus, etc., famine and fear of other countries ; grahayudah or Kethu darshan, fight amongst political heads.

Varieties of burning structures in the sky have been named as Kethu and are recognised in numerous forms. Their appearance, structure, duration, etc., have been correlated with terrestrial changes and those observations are beyond the scope of the present treatment.

CORRELATION OF MARTIAN MOVEMENTS WITH THE TERRESTRIAL EVENTS

Introduction

Based on the appearance of mars from the condition of combustion, i.e., the condition when mars cannot be seen disposed close to the sun, and gets retrograde in certain stars after travelling some distance in the starry path, five kinds of mars have been recognised and terrestrial events have been correlated with each kind of mars.

The Five Kinds of Mars correlated to Terrestrial Events

When the mars appears from combustion in the arc of some star and gets retrograde in the arc of the 7th, 8th or the 9th star therefrom, such a mars is called 'Ushnamukh' and is correlated with affliction to people who live on thermal based activities. If mars retrogrades in the 10th, 12th or the 13th star then mars is called 'Ashrumukh' and is correlated with shortage of rains, onset of epidemics and poisoning of crops due to poisoned rain waters. If mars retrogrades in the arc of the 13th or the 14th star from the one in which disappears (gets combust), mars is then called 'Vyalamukh' and an increase in the population of serpents, wild boars, etc., is caused but the earth will have plenty of food grains, etc. If mars gets retrograde in the arc of the 15th or the 16th star from the one in which it gets combust, then mars is referred to as 'Rudhiraanan' and is correlated with the onset of some kind of facial disease and plenty of foodgrains. Mars is called 'Asimusal', when risen in the 17th or the 18th star from the star in which it gets combust and is correlated with shortage of rains and danger from weapons. If mars rises in Purvaphalguni or Uttaraphalguni arc and retrogrades in Uttarashadha star, further gets combust in Rohini arc, many afflictions are reported by which all people suffer. When mars rises in Shravana arc and retrogrades in Pushya star affliction to administrators is noted. If mars is combust in Makha star then destruction to Pandyan king is noted, as also shortage of rains and danger from weapons. Further when mars transits in the middle of Vishakha then famine is noted and in Rohini epidemic. If mars transits south of Rohini then shortage of rains and inflation are noted.

If mars is seen with smoke or fire, destruction to people living in Pariyatr desh is reported. Transiting the middle portion of Rohini, Sravana, Moola, Uttaraphalguni, Uttarashadha, Uttarabhadra and Jyeshta stars, destruction to rain giving clouds is noted. Rise of mars in Shravana, Makha, Punarvasu, Moola, Hasta, Poorvabhadrapada, Ashwini, Vishakha and Rohini is correlated with plenty and prosperity on the earth.

Correlation of Terrestrial Events with the Movements of Mercury

It is generally observed that rise of mercury from combustion is usually associated with some kind of destructive phenomena on the earth involving fire, wind and water. Dissecting the starry path through the arcs of Shravan, Dhanishta, Rohini, Mrigashira and Uttarashadha mercury's movement is given to correlate with shortage of rains and fear of some kind of epidemics. When mercury transits in the middle of any of the arcs of the five stars from Aridra to Makha, war, famine, epidemics and shortage of rains is reported. If mercury dissects any of the Yogataras of the arcs of six stars from Hasta to Jyeshta it is noted to portend calamities to cattle but increase in foodstuff as also inflation. Mercury's dissection of Uttaraphalguni, Krittika, Uttarabhadra or Bharani portends destruction to life. Dissection of Ashwini, Shatabhisha, Moola or Revati arcs by mercury is correlated with affliction to business community, medicos, naval people, and destruction of oceanic produce and horses. Dissecting Purvaphalguni, Poorvashadha or Poorvabhadra arcs mercury is noted to correlate with famine, war and epidemics.

The Seven Types of Movements of Mercury

Stars	*Types of movements*	*Duration of rising or setting*
Swati Bharani Rohini Krittika	Prakrit	40 days

Stars	*Types of movements*	*Duration of rising or setting*
Mrigashira Aridra Magha Aslesha	Vibhinna or Mishra	30 days
Pushya Punarvasu Purvaphalguni Uttaraphalguni	Samkshipta	22 days
Purvabhadra Uttarabhadra Jyeshta Ashvini Revati	Teekshna	18 days
Moola Purvashadha Uttarashadha	Yogantikaa	9 days
Shravana Chitta Dhanishta Shatabhisha	Ghora	15 days
Hasta Anuradha Vishakha	Papa	9 days

Prakrit movement is noted to portend good rains, crops and plenty of good stuffs, etc. Samkshiptaa movement mixed results and other movements are noted to correlate with shortage of rains, destruction of crops, etc.

However, according to Devala, 4 types of movements of mercury have been recognised with the below mentioned correlation :

Movement	*Duration of Rise or Set*	*Correlation*
Rijwi	30 days	Welfare of people
Ativakraa	24 days	Famine
Vakraa	12 days	War
Vikalaa	6 days	Epidemics

If mercury rises in the lunar months of Pushya, Ashadha, Shravana or Magha, then people will suffer from some kind of fear; if he sets it portends good of people. If mercury rises in Kartika or Ashwiyuja lunar months, then danger of weapons or water, of fire and famine is portended.

Terrestrial Events correlated with the Jupiterian Movements

Nomenclature of the 12 Jupiterian years.

Based on the star in which jupiter rises, 12 years have been named for every two stars starting from Krittika. The fifth, eleventh and the twelfth years are of three stars each. They are given below correlated with terrestrial events :

Stars	*Year name*	*Terrestrial Events*
Krittika Rohini	Kartik	People with vehicular and thermal jobs are afflicted ; people tend to be war minded and sick prone ; but red and yellow flowers flourish.
Mrigashira Aridra	Margashir	Shortage of rains and destruction of grains due to rodents, wild animals and birds ; sickness to people.
Punarvasu Pushya	Poush	People will be happy but there will be inflation of food grains.
Ashlesha Makha	Magh	People live happy, healthy and most religious ; good rains and fair price of food grains.
Pubba Uttara Hasta	Phalgun	Crops will grow only at places and peace of people will be disturbed.
Chitta Swati	Chaitra	Little rains, poor crops, short of food grains are said but increase of grains in grannery and affliction to handsome people.

Stars	*Year name*	*Terrestrial Events*
Vishakha Anuradha	Vaishakh	Increase in food grains and peaceful earth.
Jyeshta Moola	Jyeshta	Affliction to respectable, rich and important people and to most important people and to most crops.
Purvashadha Uttarashadha	Ashadha	Shortage of rains at places and growth of crops at different places, people will be just satisfied.
Shravana Dhanishta	Shravan	Increased crops and affliction to people of irreligious temperament.
Shatabhisha Purvabhadra Uttarabhadra	Bhadrapad	The crops of seeds sown prior to the commencement of the year grow well but those sown during this year fail.
Revati Ashwini Bharani	Ashwayuj	Excessive rains, increased crops and happy people.

If jupiter transits a star on its north side then there will be peace and plenty on the earth ; if on the south side then there will be shortage of food and people will be less happy ; and moving in the middle of the star jupiter is correlated with just satisfactory nature of things.

If jupiter transits the distance of or arcs of two stars during a year, peace and plenty are correlated ; transitting the arc of two and a half stars just satisfactory nature of things are correlated ; and transitting more than the arcs of two and a half stars jupiter's movement is correlated with destruction of crops.

If jupiter resembles the colour of fire, fire accidents are noted; of yellowish white sickness; of cloudy colour war; of greenish colour losses; of red colour fear and of smoky colour rainlessness. If jupiter is seen in day time then political changes are noted.

Varahamihira then describes the 60 year cycle of jupiter. This is followed even to this day. The yuga concept of Lagadha, appears to have continued after careful improvement. In all 12 yugas, each of 5 years have been considered and the names of the 5 years appear to owe their origin to Lagadha's Vedanga Jyotisha. The names of the yugas are given below :

Names of the Yugas

Vishnu
Brihaspati
Indra
Agni
Prajapati
Ahirbudhnya
Pita
Vishwedeva
Soma
Indragni
Ashvinikumar
Surya

and it is said that the first of the 60 years cycle called 'Prabhava' commences when jupiter rises in the 1° of Dhanishta star during Magha lunar month. Out of the above 12 yugas, the first four yugas are said to be good periods; the middle four yugas satisfactory and the last four bad periods.

The year Prabhava is noted to coincide with great happiness of the biological world. But, there will be shortage of rains at places and excess of rains at other places, there will be fire accidents at places and storms in certain other places, and there will be epidemics at places and sickness due to cold at other places. However, it is generally observed that during Prabhava year life will not feel the disturbances much. The following Vibhava, Shukla, Pramoduta and Prajotpatti years of the first yuga are witnessed with gradual improvement in the living conditions.

In the second yuga, the first three years called Angira, Srimukha and Bhava are said to be good periods while Yuva and Dhatu years are noted to be of medium type. In the first three years good rains have been recorded while in the later two shortage of rains.

In the third yuga, the years Ishwar and Bahudhanya are given to get good rains; the next year called Pramathi is said to give bad results; and the last two years Vishu and Vikrama though witness peace and plenty suffer from epidemics.

In the fourth yuga, the results are given below :

Chitrabhanu	good rains, peace and plenty
Subhanu	just sufficient rains, of epidemics and death.
Tarana	excessive rains
Parthiva	crops increase
Vyaya	a period of pomp and festivity

Similarly in the fifth yuga are :

Sarvajit	
Sarvadhari	excepting the year Sarvadhari,
Virodhi	others witness unhealthy climate.
Vikrit	
Khara	

In the sixth yuga :

Nandana	the first three are favourable years.
Vijaya	
Jaya	
Manmatha	a satisfactory year
Durmukhi	a bad period for rains and crops.

In the seventh yuga :

Hevilambi	excessive rains and drought and rains charged with winds.
Vilambi	excessive rains but little grains.
Vikari	excessive rains and drought
Sharvari	famine
Plava	good rains and good crops.

In the eighth yuga :

Shubhakrit	
Shobhakrit	first two years witness peace and plenty.
Krodhi	a bad year
Vishwavasu	the last two of medium yield.
Parabhava	

In the ninth yuga :

Plavanga	a difficult year
Kilaka	the second two years good period.
Soumya	
Sadharana	short of rains and rage of epidemics.
Rodhakrit	at places rains and at some places crops.

In the tenth yuga :

Paridhavi	little rains, destruction of Madhya desh and fear of fire.
Pramadhi	destruction of red seeded vegetation.
Ananda	peace and plenty.
Rakshasa	increase in wheat and redgram, etc.
Nala	fire accident, etc.

In the eleventh yuga :

Pingala	excessive rains and epidemic cough.
Kalayukti	plenty of fruits.

Siddharti	plenty and prosperity.
Roudri	destruction of crops and people.
Durmati	even rains.

In the twelfth yuga :

Dundubhi	increased crops.
Rudhirodgari	terrific rains.
Raktakshi	epidemics.
Krodhana	unpleasantness in public.
Akshaya	much destruction.

Correlation of the Movements of Venus with Terrestrial Events

Based on rising or setting of venus in various starry arcs, the changes in biological and climatological fields have been noted. They are given below :

Rising or Setting of Venus in the arcs of	**Biological and Climatological Changes correlated with**
I. Mandala :	
Bharani Krittika Rohini Mrigashira	Peace on the earth excepting Anga, Vanga, Kalinga and Mahisha regions; political changes if there be association of any other planet with the rise of venus in Bhadrashwa, Shurasena, Youdheyika and Kotivarsh regions.
II. Mandala :	
Aridra Punarvasu	Production of excessive crops; association of other planets with

Pushya Ashlesha	the rising venus is denoted to correlate with degeneration of the people of Mithila, forest dwellers and people with jobs of thermal nature.

III. Mandala :

Makha Pubba Uttara Hasta Chitta	Famine is noted, if venus is with other planets when rising then destruction of people of Poundra, Aparant, Shoolik, Dravid and maritime areas.

IV. Mandala :

Swati Vishakha Anuradha	With other planets venus rising indicates affliction to people of Kirata, Pratyanta, Avanti, Pulinda, Tengana and Shoorasena regions.

V. Mandala :

Jyeshta Moola Purvashadha Uttarashadha Sravana	Famine and epidemics are noted; and indicates affliction to peoples of Kashmir, Ashjmaka, Matsya; if rising venus is with other planets then affliction to peoples of Dravid, Abhir, Ambasht, Trigart, Sourashtra, Sindhu Souvir and Benaras regions.

VI. Mandala :

Dhanishta Shatabhisha Purvabhadra	Peace and plenty rule the earth ; if venus rises with other planets then, affliction to peoples of Gandhara,

Uttarabhadra Revati Ashwini	Avanti and Shoolik regions and destruction to people of Videha.

If venus is seen during sunset, some kind of fear is portended; if during the day, then famine and epidemic is denoted; if seen in mid-day with moon then some kind of political disturbance is said.

Venusian movement dissecting Krittika star is noted to coincide with excessive floods. Dissecting the star Rohini, venus indicates excessive deaths. In Mrigashira venus is correlated with destruction of crops; in Aridra excessive rains and destruction of people of Kalinga and Koshal regions. Epidemics rage Ashmak and Vidarbha regions when venus moves through Punarvasu star; in Pushya venus indicates excessive rains; moving in Ashlesha venus is indicated to afflict people with serpents and in Makha with excess rains; similarly the results of venusian movement in other stars is given in the table:

Movement of Venus in stars	*Results correlated*
Pubba	Excess rains and destruction of people of Pulinda and Shabara regions.
Uttara	Affliction to people of Kuru, Punjab and Jangala regions.
Hasta	Little rains and affliction to artists and people of Kuru desh.

Movement of Venus in stars	*Results correlated*
Chitta	Considerable rains.
Swati	Excess rains and epidemics to naval, business and ambassadorial people.
Vishakha	Good rains but difficulties to business community.
Anuradha	Differences amongst administrators.
Jyeshta	Death of chief administrator and no rains.
Moola	Death of chief surgeons.
Purvashadha	Life in water in danger.
Uttarashadha	Spread of epidemics.
Sravana	Ear diseases.
Dhanishta	Affliction to people who disbelieve the Vedas.
Shatabhisha	Affliction to people of bar shops.
Purvabhadra	Considerable rains and affliction to gamblers, people of Punjab and Kuru.
Uttarabhadra	Affliction to fruit plants.
Revati	Affliction to travellers.
Ashwini	Affliction to stables' lords.
Bharani	Affliction to Kirat and Yavan people.

If venus rises or sets in the 8th, 14th or new moon day of dark half, then there will be plenty of rains. If jupiter and venus are disposed opposite to each other, then people will be afflicted of many diseases, and no rains will occur.

If jupiter, mars, mercury or saturn are set in front of venus then there will be destruction of vegetation, no rains and breaking of mountains by thunderbolt.

If the colour of venus resembles that of fire, then fear of fire is noted; of red then danger from weapons; of golden streak then diseases; of parrot green colour then heartrending cough and of ash colour no rains.

Correlation of the Movement of Saturn with Terrestrial Events

At the outset, Varahamihira observes that when saturn transits Sravana, Swati, Hasta, Aridra, Bharani or Pubba stars and is with shining rays, then earth will be drenched with rain water; transiting the arc of Ashlesha, Shatabhisha and Jyeshta, though the earth will receive little rains will be clad with green coat of luxurient vegetation and transiting the arc of Moola star, famine, shortage of rains and war tendenciss will grip the earth.

Saturn's movement in individual stars is correlated with the events mentioned as below :

Star Arc	*Events*
Ashwini	Affliction to horses, horse men, posts, medicos and ministers.

Star Arc	*Events*
Bharani	Affliction to musicians, dancers, people of orchestra and hunters.
Krittika	Affliction to people of thermal based jobs; destruction of army commanders.
Rohini	Affliction to people of Koshal, Madra, Kashi, Panchaldesh and those who earn livelihood on vehicles.
Mrigashira	Affliction to people of Vatsa desha, priests who conduct sacrifices, and people of Madhya desh.
Aridra	Affliction to people of Parat and Madras desh, washermen, thieves.
Punarvasu	Affliction to people of Punjab, Pratyanta, Sourashtra, Sindh, Souvir.
Pushya	Affliction to people of Yavan, Kirat, business community and rogues.
Ashlesha	Affliction to oceanic produces.
Makha	Affliction to people of Bahlika, China, Gandhara, Shoolik and Parat desh as also business people, bankers. and kirats.
Pubba	Affliction to people of Maharashtra and those dealing with chemicals and six rasas.
Uttara	Affliction to people of Taxila, beggars and jaggery, salt, etc.

Star Arc	*Events*
Hasta	Affliction to people of Koshal desh, gardeners, elephant capturers, body sellers, hair dressers, potters, medicos and architects.
Chitta	Affliction to womenfolk, artists, writers, and treasurers, etc.
Swati	Affliction to people of Magadh, naval people, ambassadors, drivers, dancers.
Vishakha	Affliction to people of Trigart, China & Kukut ; destruction of lac, haldi, kusumbh vegetation.
Anuradha	Affliction to people of Kulut, Tengan, Nepal, Kashmir; architects and potters.
Jyeshtha	Affliction to kings, priests, those respected by kings, strong and groups.
Moola	Affliction to people of Kashi, Koshal and Punjab; also fruits, medicines and fighters.
Purvashadha	Affliction to people of Anga, Vanga, Koshal, Girivraj, Magadh, Poundra, Mithila and Tamralipti regions.
Uttarashadha	Affliction to people of Dasharn, Yavan, Ujjain, Shabar, Pariyatr and Kuntibhoj.
Shravana	Affliction to government servants, medicos and priests.
Dhanishta	Victory to the Magadh king and bankers.

Shatabhisha & Purvabhadra	Affliction to medicos, poets, bar-masters, dalals.
Uttarabhadra	Destruction of many vehicle owners, those living on river banks, architects, womenfolk, and gold.
Revati	Affliction to peoples of Krounch isls, shabaras, yavanas and people in the service of kings as also crops of Shardrt.

When jupiter is disposed in Vishakha star and saturn in Ashwini star, then there will be moral degeneration of people. Also, great fear and enmity among citizens is portended when both jupiter and saturn are disposed in the arc of one star.

Saturn, if appears of variegated colour, then there will be destruction of birds ; yellowish then famine, red colour war ; ash colour enmity amongst citizens.

Thus it can be seen the general observations on the biological, climatological, meteorological sociological and environmental changes noted by various authorities earlier to Varahamihira have been presented by him in a manner which is befitting to a student of the earth who is concerned with all aspects of life, and who sees the earth in the context of the universe. However, these observations may not include all those jobs found at the present juncture of human civilisation, for example pilots, mechanists, drillers, etc., etc. strictly speaking, the present compartmentalisation of scientific desciplines may not include these studies under the earth science, but any study which has no relevance to human improvement is of little use. The situation is being improved by introducing inter disciplinary subjects and studies of environmental science subjects would certainly involve these and many other observations so necessary to the modern civilisation. A broad based 'Earth and Planetary' science division need include these studies in the modern context and these and more observations should have a sound base of the Theory of Earth.

Additional Observations by Varahamihira

Varahamihira has compiled many more observations on the correlation of terrestrial events with the lunar combination of other planets in various sectors of the ecliptic. He has observed that planets in group and in combustion indicate great famine, epidemic, etc., in those areas on the earth indicated by the specific sector of the ecliptic. A correlation of starry heavens with specific areas on the earth has been presented but how far it is correct is to be examined by long-standing observations. He has considered the Indian continent as the shell surface of a tortoise and each starry arc has been noted to govern certain areas within the continent. The given list in the Brihatsamhita, although might have been prepared after very long observations, the names cannot easily be correlated with the modern nomenclature of those areas and the scientific basis of such a nomenclature of those areas and the scientific basis of such a correlation is debatable. But, Varahamihira gives prime importance, as it should be, to the aspect of formation of rainy clouds, the nature of rains, the climatic and food influence of rains, etc. He observes that the foundation of life is food and the growth of food is controlled by rainy season, i.e., Varsart which include the lunar months Shravan and Bhadrapad, hence, this period should be examined in greater detail to know more about the annual rainfall and related aspects.

Accordingly, some early observation is that the rain clouds form after Kartik shukla poornima, i.e., the full moon day of lunar Kartika month. However, Garga has observed that the nature of rain-giving clouds should be judged from the disposition of moon in Purvashadha star after the new moon day of lunar margashir month. Further, it is observed, that the star in which moon is situated and rainy clouds form, 195 days from that day rain will fall. It is also observed that exactly on the 195th day after the formation of rainy clouds in the star in which moon is situated, the same star will rule by Savana mana and not by Chandramana.

If the rainy cloulds have formed in day time then rain will occur in the night ; if in bright half rain in dark half ; if in morning rain in evening ; also in the reverse order. Similarly the direction of formation and precipitation of clouds and rain are said to be in opposition relationship.

Fall of meteorites and meteors, burning in the sky, earthquake, perturbation of planets, thunderbolt, eclipse, etc., at the time of formation of rainly-clouds will destroy those clouds and disturb the rains and cause food imbalance. Clouds formed in Uttarabhadra, Uttarashadha, Purvashadha, Rohini and Purvabhadra in any season are stated to give plenty of rains. The clouds formed in Shatabhisha, Ashlesha, Aridra, Swati or Magha stars remain full for long time. There will, however, be no rains so long they are disturbed by natural calamities. If rainy clouds are formed in any of the above five stars during Margashira month, then it will cause full 8 days rain, 6 days rain in Pushya month, 16 days rain in Magha month, 20 days rain in Phalguna month, 20 days rain in Chaitra month and 3 days rain in Vaishakha month.

A rainy cloud developed with all favourable aspects is said to rain over a hundred yojana area (one yojana is about 4.9 square miles) and the least rainy clouds may rain in area less thon five yojanas. The measurement of rain water by 'Drone' and 'Adhaka' system has been presented.

If the star in which rain clouds are formed is associated with planets like sun, mars and saturn, then rains with fishes, thunder and lightning will take place. If the sun or moon situated in the star of rainy cloud is aspected by mercury, venus or jupiter, then clouds form which give excessive rains. If the clouds are held for long time, then the rain will be of hailstones; and at the formation of rainy clouds if there be rains, thunderbolt, lightning, etc., then there will be poor rains, the clouds having been destroyed.

The clouds are formed during the four days after Jyeshta shukla ashtami (the 8th day of the bright half of lunar month of Jyeshta). Pleasant wind coming from north, north-east or east and pleasant sky portend favourable cloud formation. In the bright half of lunar month Jyeshta, if there be rains when the moon is transiting the arc of Swati, Vishakha, Anuradha and Jyeshta stars, then there will be no rains during Shravana, Bhadrapada, Ashwayuja and Kartika lunar months respectively.

Then Varahamihira describes in detail the various methods like the 'Rohiniyoga' and 'Swatiyoga' employed for ascertaining the nature of annual rainfall. Based on the nature and extent of the disc, hue, movement and other aspects of the moon transiting Rohini during dark half of Ashadha month, Swathi during the bright half of the same month and Ashadha during the full moon of the same month, many observations have been made which help to ascertain the nature of rains.

Many observations have also been made based on the nature of winds. Certain indications when immediate rains fall are also presented.

Although these observations are specially within the purview of modern meteorology, the subject is very much to do with earth science in the larger context. However, the depth of the theory can be examined when Varahamihira presents his observations on one of the most fascinating and at the same time stumbling branches of modern geology and geo-physics, the problem of earthquakes. Also his treatment of groundwater inventory and civil engineering and architectural aspects of the earth and earthy materials are no less modern. The present writer has given the details of these topics elsewhere.

Of course Varahamihira's contribution, if any, on the subjects of mining and metallurgy are not known. He also does not include anything about alchemy or related subjects in the text. It can be appreciated that in these ancient times, though Kautilya's Arthashastra includes chapters on mining and metallurgy, there appears to have been no attempt to preserve the ores and mineral samples on the lines of a modern museum. Both the authors of Brihatsamhita and Arthashastra are good gemmologists. The absence of systematic study of all the materials of the earth, appears to indicate that only selective appreciation of earth materials were prevalent during those times.

Varahamihira's contribution to the Vedic Theory of the Earth — An appreciation

A brief outline of Varahamihira's contributions to the Vedic theory of the Earth presented in the foregoing can easily be said to be splendid and unique compilation of earlier observations with his critical remarks and original contributions. A most useful theory of this type, which has been held in high esteem even to this day by astronomers well versed in sanskrit language, is itself a testimony to the outstanding contribution made by Varahamihira, specially in the distant past and when the concepts of modern science of earth were non-existent. Although a theory of the earth of the type propounded by the early observers in India may be distinct from the modernity and only of utilitarian outlook, this theory can easily form as a 'Working Hypothesis' for the modern students of the earth. While it may lack many of the aspects of modern geological subjects, yet it has the truth and elegance enveloped in poetic language.

While critics may observe that the concepts of the theory are mostly extra-terrestrial and there is little of geology in the modern sense, critics also should admit that there is not even a working hypothesis of similar utilitarian outlook in the modern concepts of geology which was rather purely terrestrial and confines to the study of earth materials mostly. A theory which can help geological planning based on earlier observations of natural phenomena in various habitable regions of the earth is due. In this connection, the theory of the earth is Sanskrit literature and the concepts of modern geology may be complementary to each other.

Reference

Brihatsamhita of Varahamihira : Chowkhamba Vidyabhavan Series, Banaras, 1959.

TOWARDS AN INTEGRATED COSMIC THEORY OF THE EARTH

Introduction

The interaction between life and the earth is older than 3000 million years, but an attempt to know about the earth has been very recent indeed compared to this long acquaintance. Human evolution is very recent and the onset of civilisation more so. Even the civilised man, who mined the earth for things of his interest, did not bother to make inquiries into the earth so long as his ambition was quenched by the available resources, which were virgin. But, when his thirst for the materials of the earth increased, then he started making detailed studies to understand that the materials of the earth, though appear to be distributed rather at random to look at, they are not so and their distribution is based on certain natural principles. Thus evolved geological sciences.

Though observations were prevalent on various aspects of the earth, it was not until about 1795 a 'Theory of the Earth' was proposed in Europe by the celebrated physician James Hutton. The necessity of a theory of the earth is to understand the origin and evolution of the earth and its behaviour by which all the terrestrial phenomena can be explained and predicted. Many cosmological theories of the origin of the earth were in existence by the time of Hutton and also a school of thought which attributed all geological phenomena to the action of water. Some of them were really fantastic. Hutton observed that "Not only are no powers to be employed that are natural to the globe, no action to be admitted of except those of which we know the principle, and no extraordinary events to be alleged in order to explain a common appearance, the powers of nature are not to be employed in order to destroy the very object of those powers ; we are not to make nature act in violation to that order which we actually observed, and in subversion of that end which is to be perceived in the system of created things . . . and he presented that "The doctrine, therefore, of our Theory is briefly this, That, whatever may have been the operation of dissolving water, and chemical action of it upon the materials accumulated at the bottom of the sea, the general solidity of that mass of earth, and the placing of it in the atmosphere above the surface of the sea, has been the immediate operation of fire or heat melting and expanding bodies. Here is a proposition which may be tried, in applying it to all the phenomena of mineral regions ; so far as I have been, it is perfectly verified in the application".

It is no exaggeration to observe that the Huttonian remarks that no powers which are not natural to the earth need be put forward to explain the changes on the earth is still continuing in the minds of earth scientists who wish to explain everything observed on the earth by some endogenic force. Of course, it is very difficult to get over some kind of understanding which has the seal of tradition and antiquity. Copernican theory was looked with righteous horror, Galilio's conclusions cost him life imprisonment ; in spite of the established relationship of the spin of the earth to the forces which are extensive in nature and hold the earth to all other heavenly objects, it is rather difficult to look to the final cause of all changes of the earth within the earth itself to the exclusion of the Universe at large. It is needless to explain to a modern student of the earth that the earth is a material representative of the Universe, in dynamic equilibrium with all other heavenly bodies. Dimensional analyses have shown that although the earth is rigid twice as the steel, yet it crumbles into powder like putty when operated under forces to which it is subjected and which are extensive in space and time (Barth, 1962). When forces like gravity can be able to move in dynamic equilibrium bodies like the planets in a perfect harmony, should such forces be neglected in evaluating theories of the planets? It is also observed that forces like gravity are very feeble and the ratio of electrical interaction and of gravity interaction is about 40. It is rather difficult to understand how such feeble forces can be able to spin planetary bodies.

That apart, many research projects are revealing the foundations of geological causes being related to various geophysical phenomena of annual periodicity. The earthquakes, the Chandler movement, the duration of day, etc., have been related to annual fluctuation of gravity (Kropotkin and Trapiznikov, 1965). The slightest change in the orbital motion of the earth will be sufficient to create geological havoc. These and many other observations have been revealing that our understanding of the earth is rather imperfect to make out a satisfactory theory of the earth, even to this day.

The principles of geology got recognition and status of a science about the 18th century and government recognition in the form of instituting geological surveys is as late as the beginning of the 19th century. Most of the countries of the world have their geological surveys and at the present juncture of the civilisation, a major part of the surface of the earth has been geologically mapped. As a result of these systematic studies, earth's behaviour has been slowly unravelled, though extensive studies on the global scale are yet to be completed in order to enable the modern scientist to make a theory of the earth.

Similarly the astronomical studies also need more and more observations, though many concepts of evolution of stars and galaxies have been known. It is needless to emphasise that the earth is a representative of the Universe and in this context no study of the earth can be said to be complete until all the necessary studies of astronomy, cosmology, meteorology, climatology, etc., have been mastered and integrated.

In any case this is a problem so stupendous as the Universe is, but it is also true that the problem grows with more and more observations. Hence, it is felt that a 'Cosmic theory of the Earth' in the form of a working theory may be formulated by which annual predictions of geological events can be made for specific countries based on the data that are available now from both the Vedic theory and the modern science. An integration of data to arrive at a universal theory has been suggested herein, which can be put to test and improved upon.

The Earth in relation to Universe

The earth is related to the Universe through the Sun, and the Galaxy. The earth's annual journey round the sun sets it in different dispositions from the sun with different starry background. The sun's sojourn around the centre of the galaxy is rather over long period and the effects of star on the sun is difficult to ascertain with reference to the galactic centre. Of course, geological evidences can be correlated.

Most of the observations available of the sun's influence on the earth when the latter is disposed in different positions has already been summarised as given by Varahamihira. Tha nature of the solar changes have been recorded and its effects on the earth. It may be mentioned here that the earth will be receiving the effects of sun influenced by the stars as stated by Hoyle. Accordingly, in the month of June the Taurus constellation forming the background influences the sun by its source of powerful radio waves. They have been noted to be of special interest since they pass through the corona of the sun. The free electrons of the solar corona alter the radio waves from the Taurus source and extend to far off distances from the coronal limits (p. 117, Frontiers of Astronomy, 1957). Such solar prominences will affect the earth in a significant manner and the electrical and electromagnetic fields of the earth get disturbed in turn affecting the climate, thus causing a chain of actions. Similarly, some 1500 radio sources have been known to date and their influences on the solar chromosphere, consequently on the earth have to be ascertained.

The solar movement round the galactic centre and the influences have been correlated by Tamrazyan (p. 280, Principles of Geodynamics by Scheidegger, 1963). The sun is estimated to take some 200 to 250 million years to go round the centre of the galaxy and once in the duration a terrestrial diastrophic activity has been correlated. The last one, well defined, is the Alpine-Himalayan and the Circumpacific mountain chains some 60 million years before. The exact location of the sun on his orbit round the galaxy about 60 million years ago should be considered as sensitive and causing diastrophic activities.

The sensitive point/zone causing such diastrophic activities can be examined with reference to earlier orogenis. Earlier orogenis are not exactly occurring at intervals of 200 million years but vary. It is also possible that a number of such sensitive zones must be on the solar orbit around the galaxy, which might have been caused by destructive supernovae, some may still be found and others might have completely disappeared during the long geological periods.

In the present history of the earth which is known to be over 4500 million years, the first 1000 million years history is shrouded in mystery and geological evidences are meagre, hence called 'missing million'. The peaks of diastrophic activities which appear as prominent heights in graphs prepared on the available radiometric date, though show some 13 peaks, is difficult to reconcile with, as all of them indicate great diastrophic activity involving formation of global mountain chains of the order of the Alpine-Himalayan or the Circumpacific belts now.

These sensitive points/zones might not have totally subsided and still they may be active in mild forms respecting geological ages and also the evolution of starry groups which may cause them. In such cases, it is likely that whenever the earth and the sun align themselves during the annual movement of the earth against the background of such stars, they may activate some geological events, specially the onset of volcanoes, earthquakes, etc.

Studies are being carried out by many observatories correlating the sun-spot activity with terrestrial changes. The nature of sun-spots and their correlation with changes in the biological and other fields enumerated by earlier authorities have been mentioned already. Prediction is wanting, as also a check on the earlier observations.

The Earth and the Planets

The solar influences on the earth are modified by the planets as has been mentioned in the observations by Varahamihira, especially during the eclipses. Those observations need be examined in more details and prediction part standardised. Although the sun contains 99.87 per cent of the mass of the solar system, its influence on the earth is very much modified by the influence exerted by other planetary members, since 98.99 per cent of aggregate angular momentum of the system rests with the planets. The full angular momentum of the planets is given below :

Planets and the Sun	*Full angular momentum (mvR)*	
The Sun	not more than	20
Mercury	,,	0.03
Venus	,,	0.69
Earth	,,	1.00
Mars	,,	0.13
Jupiter	,,	725
Saturn	,,	294
Uranus	,,	64
Neptune	,,	95
Pluto	,,	1
Total	....	1200.85

It can be seen from the above table that jupiter has the maximum amount of angular momentum and saturn next. Hence, the observations on annual changes made by Varahamihira on the terrestrial events are essentially based on these two major planets since deeper effects are normally correlated with their movements.

The distances of planets have been noted to correlate with the various mountain building periods of the earth since they bear an approximately equal perspective ratios between the time of orogenics and planetary distances (Haites, Principles of Geodynamics by Scheidegger, 1963, pages 10 to 14). However, this is debatable.

In the above context the observations of F. Hoyle that "Man's claim to have progressed far beyond his fellow animals must be supported, not by his search for food, warmth and shelter (however ingeniously conducted) but by his penetration into the very fabric of the Universe", is relevant. Further he remarked that "The Universe is everything; both living and inanimate things; both atoms and galaxies; and if the spiritual exists as well as the material, of the spiritual things also; and if there is a Heaven and a Hell, Heaven and Hell too; for by the very nature the Universe is the totality of all things". He has also made it clear that "There is a general impression abroad that the large-scale aspects of the Universe are not very important to us in our daily lives—that if the earth and the sun remained all else might be destroyed without causing us any serious inconvenience. Yet this view is very likely to prove wildly wrong. Present-day developments in cosmology are coming to suggest rather insistently that everyday conditions could not persist but for distant parts of the Universe, that all our ideas of space and of geometry would become entirely invalid if the distant parts of the Universe were taken away. Our everyday experience even down to the smallest details seems to be so closely integrated to the grand scale features of the Universe that it is wellnigh impossible to contemplate the two being separated." These are revelations almost similar to those of ancient Indian sages.

Important Principles

Umpteen theories are already in existence which have tried to explain the various aspects of the earth. Astronomers, Physicists, Chemists, Biologists and Geologists have proposed a number of theories from time to time, some original, some modified and yet some working. Astronomers like Kant and Laplace, Chamerbline and Moulten, Jeans and Jeffrys, and Weitzsacker have advanced theories about the origin of the earth and other bodies of the solar family. Astrophysiciste have proposed likewise theories on cosmic aspects of the earth in their concepts of Expanding Universe and Steady State Universe. Physicists have contributed much to our knowledge about the earth, including the shape, physical distribution, temperature, pressure, seismicity and interior structure, electricity, magnetism, gravitation, age and other aspects. While astronomers had already determined the size of the earth, its movements and age, the theory of gravitation by Newton brought a more rational outlook not only to the motions of the earth and the planets of the solar system, but also of all the heavenly bodies, and established the close relationship that exists amongst them. Based on the thermal aspects of the earth Kelvin made suggestions on the age of the earth in a rational form. Buffon, Joly, Darwin and others also thought about the age of the earth from various points of view. Buffon correlated the six days of Bible with his six epochs and presented a theory of the earth. Joly based his age determinations on the increasing concentrations of salt in the oceans. Darwin's ideas had the rate of evolution of life and fossil record. But of recent origin is the age of the earth determined on the radio-metric methods originally due to Holmes.

The flat earth theory, the tetrahedral theory, the origin of pacific ocean and the birth of moon, the observations of Leonardo Vinci on the coastal congruence of the lands on the west and east of the Atlantic, the antipodal nature of oceans and continents, the physico-chemical aspects and denudation of land masses, sedimentary cycle, constant level of oceans, submergence and uplift of landmasses, theory of isostasy, speculations and inferences about the internal constitution of the earth, electric and magnetic fields of the earth, meteorological theories and the influence of Van Allen radiation belts. elemental distribution in the earth, palaeomagnetic theories, etc., originated driving imagination and inferences to facts and truth, specially about the earth. Spectacular advancement in the geological mapping, chemistry of rocks and minerals, closer understanding about the origin of various mineral deposits paved the way for a detailed and clear appreciation of the processes of the earth. Advances in experimental petrology and mineralogy, land satellite photogeology, geophysical and geochemical prospecting, deep drilling and mining have all contributed to our knowledge of the earth.

Search for mineral deposits has revolutionised scientific thinking. Slowly understanding the principles of mountain building and origin of oceans through theories of Kober, Daly, Wegner, Bemmalen and many others, the unstable and less stationary than believed nature of the surface features of the earth have led to the modern concepts of the theory of Plate Tectonics. However, only now the scientists have started appreciating the importance of environment which rules over all other aspects in preserving the life. Even at this juncture, there has been little or no appreciation of the Universal influence on the environmental aspects.

All the theories in the literature describe many important aspects of the earth and the Universe. Although many of them include the origin and evolution of the earth in the larger context of the creation and evolution of the Universe, there appears to be no correspondence between the theories of the earth and those of the Universe. This is more so, since many students of the earth have strong belief that all the terrestrial phenomena can be explained by some kind of endogenic forces of the earth. The ultimate cause of such force has not received attention, as such there is hardly any appreciation of theories of the Universe by the theories of the earth.

The lack of appreciation of terrestrial aspects in the total perspective of the Universe has been the fundamental cause of the differences and partiality of the truth of all the theories. Of course, the reason generally advanced to explain this fundamental difference will be the lack of data about the earth and its materials on their rheological aspects (time dependent properties) on one side and on the other side lack of longstanding observational record for effective comparison and correlation of the cosmological aspects. Though much advance has been made in our understanding about the various aspects of the universe by astronomical and astro-physical studies, yet the data is only of a few centuries old, if not a few decades. For example, the time of explosion, spreading and dissolution of many of the supernovae are uncertain. It is said that the first of such kind to be taken cognizance of is the radio star identified as Crab Nebula which is the remnant of the supernova observed by the Chinese astronomers as having been exploded on July 4, 1054 A.D.

At present students of the earth are at a loss to appreciate the complete behavioural patterns of the earth due to a lack of appreciation of a clear understanding of the Universe and treating the earth in isolation. Although extensive research programmes are being pursued to know more and more about the earth, especially about the solid, liquid, gaseous and other physical aspects like gravitation, magnetism, electricity, etc. They are only yielding partial truths. A complete study needs a broad vision on the part of the students of the earth to formulate a theory by which all the terrestrial phenomena can be explained and can be predicted.

Towards this end are enumerated some of the more important principles which permit such an attempt :

1. The earth should be considered as a representative of the whole Universe and not as an isolated body.
2. The earth is in dynamic equilibrium with the whole Universe through the solar system which is clean from the theories of Gravitation and Relativity (General).
3. The spin of the earth which is the cause of all geological phenomena is a reflection of the changes in the Universe and any catastrophe occurring in any part of the Universe will affect in a manner notwithstanding the intensity of the universal phenomena.
4. Since the biological evolution is a characteristic of the earth alone so far known in the visible Universe, and the life is a subtle force compared to material manifestation, the life on the earth will be affected by slightest change on the terrestrial scene, the ultimate cause of which is again Universal.

5. Since the heavenly bodies treat their characteristic world-lines (orbits) in the space-time continuum, they represent, as the earth, specific aspects of the Universe as definite physico-chemical entities in space and time.

6. Through the space-time medium all the heavenly bodies are related to each other and mutually influence always but with observable effects when disposed in certain patterns.

7. Since the process of origin, evolution and dissolution of the Universe is without beginning, hence endless, these principles are more fundamental and for all times.

8. Therefore, the events—geological and biological—are space-time defined in an evolutionary frame.

9. Also there cannot be any event which is not governed by the theory.

Conclusions

Thus, a cosmic theory of the earth can be formulated incorporating the data available in early theories and explaining the terrestrial events in terms of the activities of the visible Universe. The events on the earth may be day to day ones or of millions of years and geo-astronomical scale is already in existence, which resolves many of rheological problems.

These data are to be examined in the light of modern observations and fitting the modern sociological, political and other biological settings, especially to govern all walks of life. Unless such a theory is put to humanitarian utility, it is incomplete and predictions attempted on the basis of such a theory will be partial.

The earth is the only home of life in the Universe known so far. Any theory of the earth should take this prime point of observation and to make living on the earth desirable. Also the theory should be able to advise the balanced utility of wasting assets and the renewable resources of the earth for the betterment of humanity. Only then will be geological and earth science studies find their perfection.

References

1. Theoretical Petrology: Barth, T.F.W., 1962, Willy & Co.

2. The Origin of the Earth and Planets : Levin, B. Moscow, 1958

3. Principles of Geodynamics: Scheidegger, A., Berlin, 1963.

4. Frontiers of Astronomy : Hoyle, F., Mentor, 1957.

5. Astronomy : Baker, R. H., Van Nostrand, 1965.

6. Variation of the angular velocity of the Earth's rotation, the Oscillation of the pole, and the rate of drift of geomagnetic field and the possible association with geotectonic processes, by Kroptkin, P.N. and Trapiznikov, Yv.A., International Geology Review, Vol. 7, No. 11, 1965.

7. Scientific American Resource Library, Readings in Earth Sciences, Taraporewala Private Ltd., 3 volumes, P. 1–915, Indian Edition, 1975.

উত্তরপাড়া জয়কৃষ্ণ সাধারণ
পুস্তকাগার
পুস্তক সংখ্যা
তারিখ

12164

Kalpatharu Research Academy

Post Box No. 1857 :: :: Bangalore-18

Academy has already published :

- Sri Chakra, its Yantra, Mantra and Tantra
- Concept of Ganesha
- Sri Sukta
- Hymns to Devi
- An Integrated Theory of the Earth

Projects on hand :

- Descriptive Glossary of Indian Iconography (in three volumes)
- Agama Encyclopaedia (in twelve volumes)
- Veda Darshana
- Running of Veda Patashalas

J4